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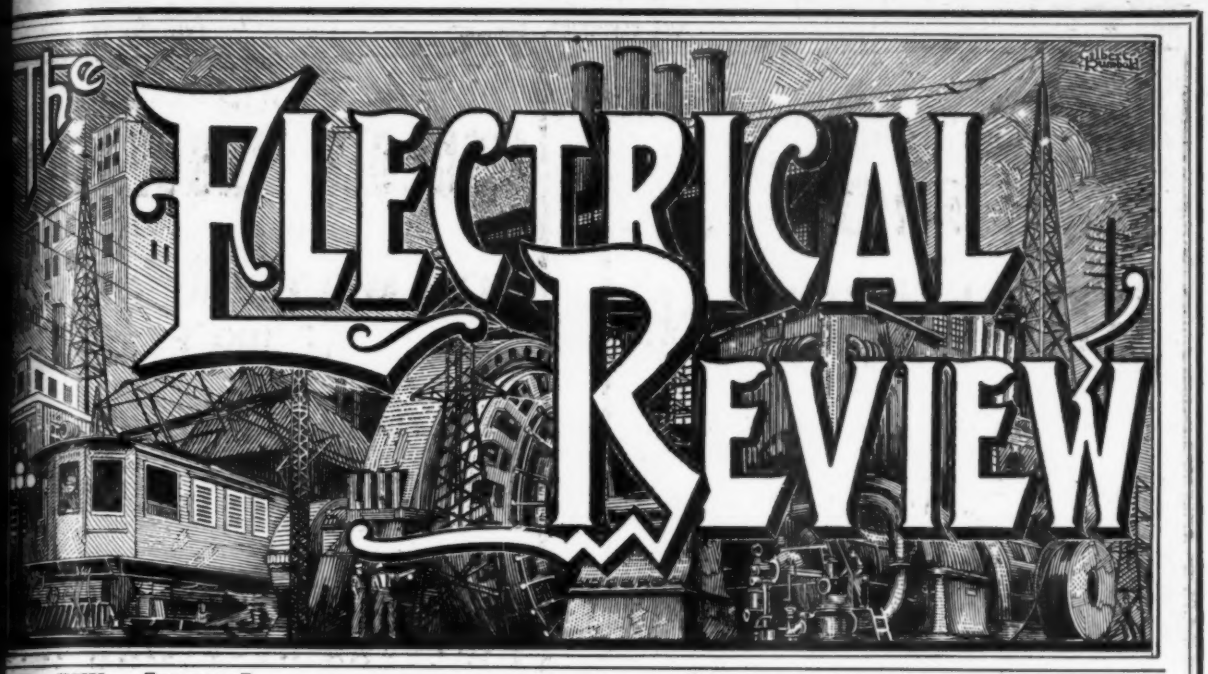

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ELECTRICAL REVIEW.

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LOOKING AHEAD.

SEVERAL years ago fears were entertained by some of our leading engineering industrial authorities that we should be at a serious disadvantage because of the shortage of skilled men in the electrical and other technical trades. In the early years of the war many men in these trades eagerly took up arms, as did very large numbers of experienced men employed in the mines. This rush to the Colours helped to delay the enemy's advance, but it placed us at a disadvantage, and as the need for retaining such men for essential service in munition works became recognised measures were taken for organising the man power of the country along selective lines; these measures reduced the outflow, thus preventing the available army of skilled workers from being depleted to a danger point. The early expectations of post-war engineering requirements and the loss of so many men of technical skill who fell in the fighting gave rise to the fears which we have mentioned. When the forces were demobilised, however, owing to the dilution and other processes which had been adopted, there was no shortage—rather the reverse—of certain semi-skilled classes of labour. If the trade boom that followed hostilities had continued, the early fears of leaders might have been realised, but unfortunately we have been passing through an unprecedented period of depression, with the result that large numbers of skilled engineering workers have left the United Kingdom and found work in the United States. To-day organised employers and employés alike deplore this movement and the necessity for it, and give expression to the fear that when our trade fully revives we shall not have adequate suitable labour at hand in the engineering trades. The new schemes that have been put in hand for relieving unemployment include some very large undertakings which will provide work for skilled men, and every such development is to be welcomed in the national interest, because it gives employment also to others as a consequence of increased activity in the other trades. There is a great interdependence between different classes of employment.

But what is happening on the other side of the Atlantic where our skilled men are being absorbed?

We have received a somewhat remarkable document from the National Industrial Conference Board of New York. It outlines the difficulties of the United States industries owing to the shortage of trained engineers—or shall we say the prospective shortage?—looking some years ahead. It tells us that, spurred by the fact that the need of big business for trained young men to become leaders is far surpassing the ability of the American technical schools to graduate men of this calibre, a committee of eminent industrialists and educationists has been holding a series of conferences in New York to seek a remedy for this difficulty.

The committee has been organised by the National Industrial Conference Board into a joint conference on engineering education. The first autumn session has just concluded preliminary meetings, and from the report before us it seems that American industry may need 400,000 more persons for positions of responsibility in 1930 than it required in 1920. The reason for this growth in demand for experts and leaders is the change of methods by which industrial work is being performed, which change consists mainly

in the development of corporations, in the increasing use of machinery, power, and other labour-saving devices, and in the elaboration of methods of control in production and distribution. Mass production greatly increases the amount of product per worker, but requires a relatively larger increase in the proportion of planners and administrators. It is considered that these facts and figures demonstrate that both the normal progress in industrial methods and the approaching new competitive conditions will call for a more decided change than ever before in the quality and number of trained experts and leaders.

The situation is being used as a message of opportunity to the youth of America, and industrial and educational authorities are at work elaborating plans for marshalling the required army of trained young men. It is felt that the needs of the next generation must be considered in the educational plans of to-day. The technical schools of the United States are now turning out about 9,000 graduates a year, and, in industry at present, less than 20 per cent. of those who now plan and administer the productive work of the nation are graduates of any college at all.

The joint committee arrived at a number of conclusions as follows:—

There is a rapidly-growing need for administrative and technical ability in practically all lines of activity. This is especially true of the manufacturing and mechanical industries.

There is an increasing demand for graduates of engineering schools to enter upon work which will fit them for positions of administrative as well as technical responsibility. This, apparently, is due to the fact that courses of education in engineering and applied sciences have in the past been highly successful in the early development of both kinds of talent.

The demand for young men with capacity for becoming administrative or technical leaders is already far greater than the number of such men now being graduated from the engineering schools.

It is equally as important that a greater proportion of the graduates of engineering schools be young men of high quality as that the total number of graduates be increased. Therefore, admission to these schools should be based on selective tests.

The preparatory schools can perform a great service to industry, as well as to the students, by properly evaluating the advantages of an engineering course and guiding toward the engineering schools the boys who have, or in whom can be developed, an interest in producing things.

There is a growing opinion that the engineering schools should provide a thorough grounding in fundamentals of engineering and applied sciences rather than specialised training.

There should be more and better training courses in connection with industrial establishments to supplement the educational courses of the colleges.

Close co-ordination of educational effort is therefore necessary between industrialists and educators.

To most of these conclusions we can heartily subscribe. Similar views were voiced by Mr. C. T. Allan in his address as Chairman of the Western Centre of the Institution of Electrical Engineers, of which we gave an abstract in our issue of October 26th. Mr. Allan laid special stress on the British engineer's lack of commercial training, an essential element of which is a due appreciation of the value of publicity—not merely as a personal matter, but in respect of the status of engineering as a whole in the public eye; he is out of touch not only with the lay Press, but often even with his own technical Press, which is, as Mr. Allan stated, most anxious to fight his cause and serve his interests, but only too frequently finds him inclined to emulate the oyster.

Mr. Allan's views were strongly supported in the discussion which followed his address. Here, as in the United States, the demand for highly trained men capable of holding responsible positions is bound to increase. Unfortunately the resources of our training institutions fall far short of those of the United States and Germany, and the cost of the training is far greater. These conditions are largely due to the lack of interest of our manufacturing firms, many of which are apt to look upon a technical college as a thing with which they have no concern—forgetting that it is to the colleges that they must look for the trained intelligence which is indispensable to the successful conduct of their own business. Let them give heed to the example of the National Industrial Conference Board and take the necessary steps to ensure an adequate supply of college-trained men; if the supply runs short, they have only themselves to blame.

Regulations for Overhead Lines.

On Tuesday last the new regulations for overhead lines prescribed by the Electricity Commissioners were issued to the public (H.M. Stationery Office: El. C. 39. Price 2d.) The regulations have been under revision for over three years, the Electricity Commissioners being assisted in this work by an Advisory Committee appointed by the Institution of Electrical Engineers, on which other public bodies were also represented, with Mr. E. V. Twiss as chairman; we may safely take it, therefore, that the new code embodies the collective considered opinion of British experts as to what are the necessary and sufficient precautions to be observed in the erection of overhead lines in order to secure the safety of the public and continuity of supply.

Receiving the regulations almost in the act of going to press, we can say but little regarding them at the moment; but a hasty perusal of the new requirements confirms our anticipation that they constitute a vast improvement over the pre-existing regulations, which had been in force without material alteration for many years, and were notoriously out of phase with modern practice as observed in other countries. The very high factors of safety previously prescribed have been drastically reduced—for wooden poles from 10 to 3.5, for iron or steel from 6 to 2.5, and for the line conductors from 5 to 2; and the wind pressure to be allowed for is 8 lb. instead of 25 lb. per sq. foot. But in considering these figures it must be borne in mind that whereas under the old regulations no allowance need be made for a possible accumulation of snow, the new code specifies that calculations must be based on the presence of ice on the conductors to a thickness of $\frac{1}{4}$ inch or $\frac{1}{2}$ inch, according to the voltage, and on the whole of the projected area of the ice-covered lines instead of 0.6 of it Strict comparison of the factors of safety of the two codes therefore would involve much computation. In other respects also the codes differ so widely that the new rules must be looked upon as entirely recast and not merely a modified version of the old ones. Congratulations are due to the Electricity Commissioners and the Advisory Committee on the completion of this valuable work.

Petrol-Electric Power.

The views recently put forward by Mr. L. Murphy before the Institution of Automobile Engineers, which we summarise elsewhere in this issue, are of considerable interest to electrical engineers, in that they indicate that there is a large field for economy in the propulsion of road vehicles by the adoption of the petrol-electric system combined with the battery system. The author states that the ordinary petrol-driven commercial vehicle gives a result of about 40 ton-miles per gallon unladen, rising perhaps to 65 ton-miles per gallon fully laden; a battery-driven vehicle, obtaining its charge from a stationary petrol-driven dynamo, will give 68 ton-miles per gallon in spite of the low efficiency of this method, but if a generating set and battery are suitably designed and carried on the vehicle, a result of at least 90 ton-miles can be secured under the worst conditions, and this may be increased to 130 ton-miles per gallon under the best conditions. At the same time, advantages are gained by eliminating variable-ratio mechanical gearing and by increasing the mileage per charge.

Electric storage batteries were first used on petrol cars for ignition and lighting; then they were made bigger and used for starting; it seems possible, if the author's contentions are substantiated, that they may next share in the driving—and finally we shall arrive at the all-electric stage.

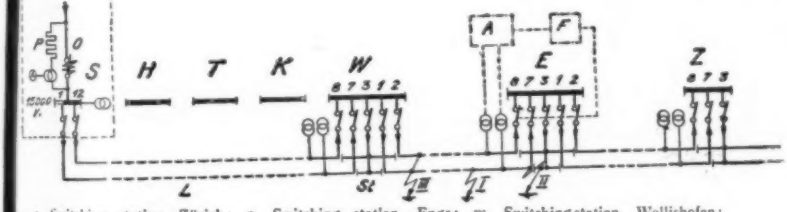
AUTOMATIC FAULT-LOCALISING ON ELECTRIC RAILWAYS.

By H. LUTHY, Aarau.

In the following article a new system of fault-localising is described, and it is shown that the difficulties in the application of the simple overload relay protection to intricate networks can be easily overcome by the new system, which requires a comparatively low initial capital outlay if an interruption of service of very short duration is of small consequence. The arrangements made to obtain this result are described on the basis of the electrified section of the Swiss Federal Railways on the line Sihlbrugg-Zürich, where the system was first applied.

This line having been put into normal service on March 1st, 1923, interesting results of tests and actual service are available. This article deals with the construction and operation of the whole combination, and presents some noteworthy features, inasmuch as this completely automatic gear necessitates a smaller initial outlay of capital than the semi-automatic apparatus hitherto employed. It represents also a highly satisfactory and practical solution of a maximum current protection for large and complicated traction systems.

The automatic fault-localising system has for its object the complete isolation of any faulty section of the trolley or other contact line in such a short time as to be without any appreciable effect on the normal service of the "healthy" parts of the line. There are other well-known protection systems fulfilling in a quite satisfactory manner the duty of section isolators in power transmission schemes, by which the faulty section is cut out between the two nearest automatic switches. This isolation is completed within a time short enough to prevent excessive heating of, and damage to, the affected parts of the installation.



Z, Switching station, Zürich; E, Switching station, Enge; W, Switching station, Wollishofen; A, Automatic control gear; F, Remote control gear; O, Automatic main feeder switch; K, Switching station, Kilchberg; T, Switching station, Thalwil; H, Switching station, Horgen; S, Switching station, Sihlbrugg; P, Testing resistance; L, Trolley line; St, Line section at station.

FIG. 1.

The application of such systems is, however, limited through size and lay-out of the network. If we consider, for instance, the conditions of the universally known and very simple protection by means of overload fixed time-limit relays, it is evident that in a large network the maximum time setting would probably exceed practical limits, or the differences in the time settings would need to be so small that accurate calibration and reliability might be found an impossibility.

Such difficulties can, to a certain extent, be countered by the application of differential relays, but here, again, certain considerations may lead to their exclusion from application.

It is claimed that the system of protection, described in the following article, overcomes all such difficulties in a perfect manner. It comprises 18 trolley-line sections, partly loop lines between the stations and partly open lines. The diagram of the section Sihlbrugg-Zürich is given in fig. 1.

The line sections in each station are connected to a busbar by means of electrically remote-controlled oil switches, the latter being assembled in separate switching stations. This interconnection permits any section to be isolated without disturbing the continuity of the line.

Current is obtained from the 15,000-volt busbars at the Sihlbrugg sub-station over a main feeder switch with instantaneous overload release, which comes into operation in the case of breakdown of insulation. The opening of this switch, however, does not cut off supply, but puts a testing resistance in circuit which absorbs nearly the whole line voltage. The current flowing over this resistance into the system is checked at the sub-station, and as soon as it has attained a certain minimum value, the attendant recloses the switch. It is at this moment that the automatic fault-localising system commences its duty of locating and immediately isolating the faulty section of the contact line.

The time at disposal for location of the fault is only dependent on the heat-absorbing capacity of the testing resistance and on the condition that the disturbance shall not in any way be noticeable in the functional adherence to scheduled time of the trains. The endangering of the line switches due to overheating falls completely out of consideration, since the test current does not exceed 7.5 amps. The fact that the faulty section is isolated is demonstrated to the attendant by the disappearance of the test current and reappearance of the full-line voltage on the healthy section.

FIG. 2.—CONTROLLER.

The automatic sectionalising is performed by two elements per station, *i.e.*, two no-volt relays and one electrically-operated controller, by means of direct current furnished by a 36-cell accumulator battery. This apparatus is mounted in the railway station itself, fig. 3, in proximity to the remote-control board for the line-sectioning switches. The two no-volt relays are fed from the secondaries of two transformers (15,000/110 volts), which are connected to the two incoming trolley lines. At Sihlbrugg only one single-phase transformer is required. The controller is operated by a small d.c. motor. In case of a short-circuit on the line, the main feeder switch is tripped and puts the test resistance in circuit, whereby the line voltage drops to a very small percentage of its normal value. This voltage drop sets all the controller motors in all the stations simultaneously in operation. The sectionalising progresses over a special contact device in the following sequence:—

The trolley section 3 at Zürich, fig. 1, is cut out, then the two sections, 7 and 8. The controller then remains in its position. There follows the cutting-out and cutting-in again of the two lines, 1 and 2, at Enge, and cutting-out of the two incoming lines, 7 and 8, in this station. This performance is repeated all along the line, and reaches eventually the two outgoing feeders, 1 and 12, in the Sihlbrugg sub-station. Through the

method of operation described it is evident that for a certain time each section of the line becomes disconnected from the line. As soon as the faulty section, in the case of fig. 1, between Enge and Wollishofen, becomes isolated, the test current disappears and the full line

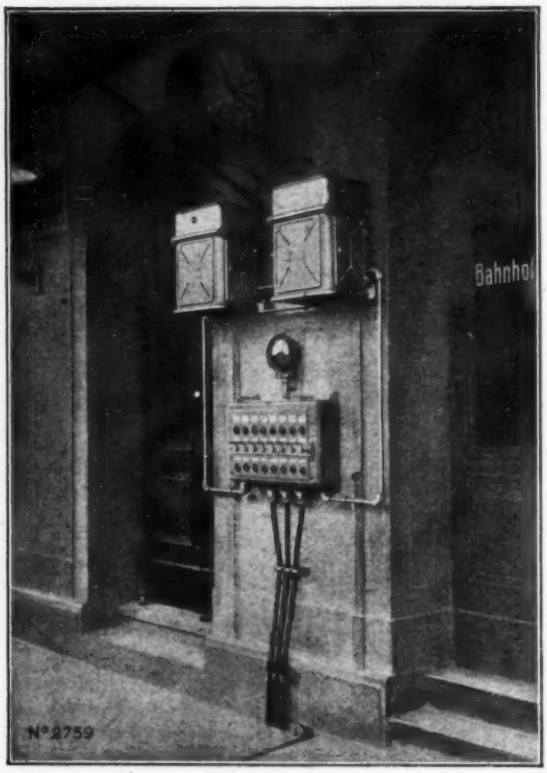


Fig. 3.—Apparatus at Station.

voltage returns. The return of the no-volt relay at Wollishofen to its normal condition stops all further action of the controllers, thus immediately isolating the outgoing line switch 1. The line voltage is communicated over switch 2 in Wollishofen to the incoming line switch 8 at Enge, which is reclosed, due to the no-volt relay assuming normal conditions, but switch 7 of the faulty section remains open, since the line voltage has not been communicated to this switch. The line voltage continues to travel over the line until the switches 7 and 8 in Zürich are closed again. In all those stations which, up to the moment of reappearance of the voltage, have not yet been reached by the switching performance, the no-volt relays assume their normal condition without leading to an opening of the switch. This is the case, for example, at the stations Kilchberg, Thalwil, Horgen-Oberdorf, and Sihlbrugg. In the last-named station the return of the line voltage leads to the automatic closing of the main feeder switch, and thus the whole line is restored to normal service. A certain time after this restoration, all the controllers on the line cease their movement. The final result is the absolutely automatic isolation of the faulty section through the opening of the incoming and outgoing switches of this section, a fact which is signalled by optical and acoustical devices.

The system permits, without any difficulty, the connection of branch lines and continuation of a number of sub-stations, so that all these sub-stations feed one large network, which is, in the case of a fault, split up into a large number of open-line sections. It is evident that as soon as this splitting-up of the whole network is established, the fault has no further influence upon the healthy sections, which receive immediately their full line voltage and resume normal service. The part of the network containing the short circuit is then sectionalised as described above.

In comparison with all the well-known overload protection systems, it is noteworthy that, with the same effect of protection, the breaking capacity required of the line switches is negligible, since they do not interrupt more than the test current at a very reduced voltage. Only the main feeder switch must be built for an adequate breaking capacity. The line switches can therefore all be of a comparatively light and cheap design. This consideration is, for traction work, especially of great advantage, since it permits the extensive use of the sectionalising idea and allows of the installation of full automatic protection, which would not be the case with oil switches of large capacity.

The prime condition for the isolation of a faulty section is the proper sequence of the switching operation from station to station, which is obtained by synchronism of all the controllers in the various stations. The controller drums are set so as not to overlap each other in their action. The controllers assume synchronism automatically, since each controller drum completes one revolution through the failure of the voltage without being in any way influenced by the further occurrences on the network; the time for one complete revolution of all the controllers is set for a constant value, which in turn is checked by a speed-regulating device, necessary owing to the variable voltage of the battery (mean value 72 volts).

Description of the Various Apparatus.

The controller is shown in fig. 2, the side and top coverings being removed to permit a view of the inside of the controller. The upper part is occupied by the operating mechanism with the regulator, whereas the two controller drums are arranged in the lower part. One of these drums provides for the proper sequence of operation of the five switches in their respective stations, whereas the second drum serves for ensuring the proper moment for starting the aforesaid operation. An adjustment with scale permits of the selection of the desired and exact moment at which the switch is to be operated. The first controller drum makes several revolutions to

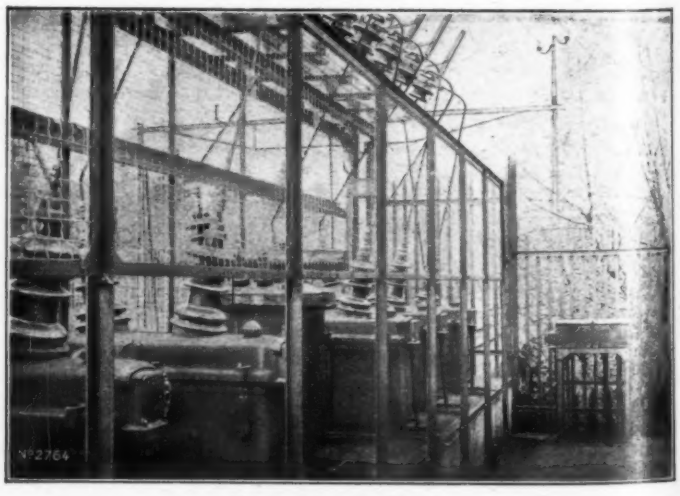


Fig. 4.—Switch Group.

one revolution of the second drum. The contact fingers are of a specially strong design with strong spring action. It may be noted, as a special advantage, that these contacts do not break circuit under current, so that the nature of the contacts and segments is immaterial. Further segments are provided for special purposes.

The operating apparatus for the controller are con-

tained in a relay case, fig. 3, which contains also the main switch and a signal lamp which indicates a fault on the line and also the coming into operation of the automatic gear. The relays are simple voltage relays, and the contacts are arranged so that they do not break circuit under load.

The remote-control operating gear, fig. 3, consists of the control switch and red and green signal lamps. In case of a fault, the various control switches are automatically and electrically interlocked, so that it is not possible for the proper procedure of the automatic gear to be disturbed. Provision is also made so that any section which is isolated, due to repairs being carried out, is not in any way influenced by the automatic operation of the sectioning gear, so that there is no danger of any such section being inadvertently connected to the line. The various handles for operating switches are interlocked by a special bar which can

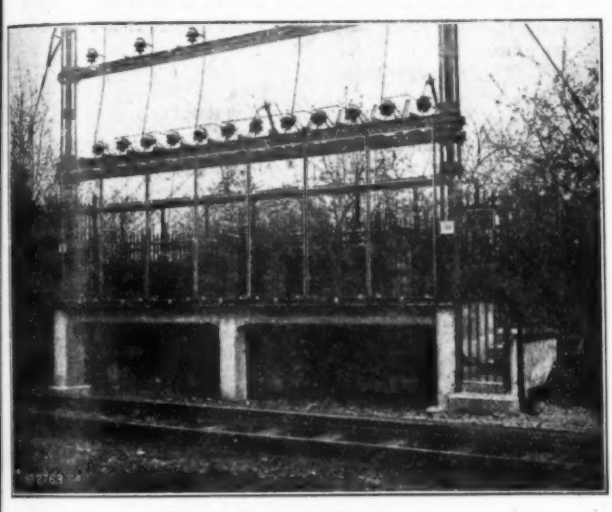


Fig. 5.—Outdoor Switchgear.

only be liberated by the signal lamp. A voltmeter on the top of the case can be connected by means of a suitable change-over switch to one or the other of the interconnecting feeders. The front of this control box is hinged so as to give access to the interior.

The line switches are built as outdoor switches for 24,000 volts and 600 amps., and the control magnets are contained inside the oil tank; each single-pole switch is fitted with a hand-wheel for easy manipulation. Figs. 4 and 5 show complete switch groups.

Besides the oil switches, each box contains isolating switches and a transformer, the latter being protected by corona-free primary fuses. These fuses are arranged so that the fuse-holders can be handled by the same operating rod as is used for the isolating switches.

The supply and erection of the apparatus described above was carried out by the electrical apparatus manufacturers, Sprecher & Schuh Co., Aarau, Switzerland; the apparatus for automatic fault-localising is covered by patents held by this company.

Service.

In most cases the drop in voltage on the line is the result of the breakdown of an insulator or a direct earth due to a mechanical defect. If the "shorts" clear themselves within five seconds, none of the oil switches is operated. If, however, the "shorts" are dead earth, as they will be in most cases, the automatic apparatus will come into operation in the manner described above. In each station the sectionalising process can be followed on the control box, since the green lamps will indicate how the localising is proceeding. The duration of the switching action is four seconds for an open station containing five switches; for the entire line from Sihlbrugg to Zürich the selection and localising of the faulty section absorbs 40 seconds. Further tests which have been carried out prove that this time can be reduced to about half without in any way affecting the safety and accuracy of operation of the whole combination. The above indications prove that in the most unfavourable case, *i.e.*, if there should be a fault in the sub-station itself, a period of 40 seconds would elapse until the voltage returned. This would not be in any way of disadvantage to the normal service on the line, since it may be assumed that any trains which happened to be on the line at that moment would overcome the 40 seconds due to their kinetic energy. For any trains which are on the point of starting, this delay is of no consequence. It may be interesting to examine the restoring of normal conditions of service if a train happens to be travelling along a healthy line section when the sectionalising sets in. The fact that the main switch on the locomotive is fitted with no-volt release does not exclude the possibility that the engine-driver may try to close the switch just at the moment when, afer clearing the fault, the full-line voltage returns. Tests which have been carried out to this effect on the section Zug-Goldau have shown that the above-mentioned condition may even happen simultaneously in two locomotives, without in any way endangering the proper functions of the automatic gear, since the current taken by the locomotives across the test resistance does not bring the drop of voltage low enough to set the no-volt relays in operation.

The special arrangement of the double trolley line and the station line on the point of the block signal seems to allow the possibility that a "short" may develop which would communicate itself to two-line sections; for instance, the line switch 7 and the station line switch 3 in fig. 1. The automatic gear deals with this case by opening first the switches 7 and 1, and then sectionalising the fault from the healthy lines.

A further possible short circuit may be established through the simultaneous earthing of the two trolley lines nearest to one another. In this case the two incoming feeder switches 7 and 8 remain open in spite of the return of the normal voltage on the line. It will be seen that in this case also the complete part of the network remains cut off, but this is not of very great consequence, since the feeding of the healthy parts could not then in any case be accomplished.

The failure of voltage is not always the result of a short circuit; it is evident that the voltage can fail if, for instance, the sub-station should be cut off from the power station. In this case the same method of separation would set in, but the line switches of the incoming lines would remain open until, with the reappearing of the line voltage, they were automatically closed again. Under certain conditions it may occur that the voltage of the line does not drop to zero. This would be the case when a second contact line under full a.c. voltage ran near and parallel to the dead line, which would occur at the point of junction between a section out of service with a part of the line actually operating. In this case the two lines would be at a distance from each other corresponding to the distance centre to centre of the two traction lines. It is evident that in such a case the live line will induce a voltage in the parallel dead line, this voltage being dependent on the relation of the capacity between the two wires to the capacity of the influenced wire to earth. Calculations and actual tests in this respect have shown that if the two trolley lines are run parallel for a length of only 5 km. a static voltage of a value up to 6,000 volts may be induced.

Upon the electrification of the line Thalwil-Richterswil, owing to the necessity of the parallel arrangement of the contact lines at Thalwil and Horgen, the effect of the above-described condition has been met by keeping the capacity of the dead line to earth as large as possible. This result, however, was only obtained by the fact that the trolley line forms one continuous unit from Sihlbrugg to Zürich.

For this purpose the above-mentioned special segments are fitted in the controller, which connect the incoming

double trolley lines after the test or sectionalising of the complete line has been carried out.

The proper operation of the whole combination has been proved through artificial "shorts" which have been established to correspond to any of the above-mentioned possible cases of fault which may actually develop during service; since then, on a number of occasions, the gear has been given the opportunity of demonstrating the great reliability and accuracy with which it clears the entire network within spheres of operation of any "short" which may develop.

The application of this system is not confined only to single-phase working, but is also applicable to any other system. In the case of d.c. systems the line-sectioning switches would be a simple form of contactor switch.

ACCURATE METERING.

By S. H. RICHARDS, A.M.I.E.E.

1.—Importance of Accuracy.

IT is a short-sighted policy that will carefully scrutinise the cost of generation and neglect the meter, or "cash register" between the consumer and the supply. Such a policy has often been found to result in losses exceeding the gains made at the generating end, thereby increasing the apparent cost of supply, whereas a close scrutiny of the meters and the maintenance of their accuracy has invariably led to lower cost and smaller charges, producing in turn an increase in the number of connections.

After its installation a meter is the point of contact between the supply authority and the consumer, and is the definite indication of honesty of intention of the engineer to his consumer. It therefore holds that unless a meter is accurate (within the limits prescribed by the electrical authorities), the engineer may unintentionally be increasing profits at the expense of the consumer, or decreasing them to the benefit of the consumer.

Operating, as a meter does, under the most varied conditions, the necessity arises for a close scrutiny and systematic test of all meters. A meter must be accurate for varying voltages and wave forms and also when subjected to vibration, extremes of temperature, and moisture, conditions which so often prevail on circuit. It must also operate for months or years without any supervision, under any or all of the above conditions, and is expected to register as accurately as on the day when first installed. The conditions enumerated call for a meter which is accurate not only during its initial tests, but also after ageing.

Meter accuracies can only be maintained by a frequent and intelligent inspection and test not only when a meter has been received from the manufacturer, but also at periodic intervals, such as 3/5 years, or at such times as may be considered necessary by the supply authorities.

2.—Official Standard Specifications.

In this article the word "accuracy" has a meaning other than absolute accuracy, and is used to denote the limits of error permissible within which a meter may be deemed to be accurate.

In different countries standardisation committees, electric light associations, insurance companies, and other controlling bodies have drawn up a series of rules and regulations which define the accuracy of meters within certain limits. The accuracies called for in Great Britain are tabulated below. An examination of the accuracies called for in other countries shows that the British specification compares favourably with them in safeguarding the buyer and, at the same time, allows the manufacturer to produce a good meter at a reasonable price.

The British rules state:—

DIRECT-CURRENT METERS.

A direct-current meter is deemed to be accurate when it complies with the following conditions, and its errors do not exceed:—

Without shunt—

From full load to 1/5th load	...	±2.0%
From 1/5th to 1/10th load	...	±2.5%
At 1/20th load	...	±4.5%

With shunt—

From full load to 1/10th load	...	±2.5%
At 1/20th load	...	±5.0%

The meter must also comply with the following conditions:—

Starting Current.—Not to exceed 1 per cent. of full load or not less than 0.05 amp.

Remarks.	Load.	Allowable error % + −	Starting load.	Variation of pressure.	Allowable error % + −	Variation of periodicity.	Allowable error % + −	Excess current.	Variation of power factor %	Allowable error % + −	Variation of temperature.	Non-registration with pressure only.	Excess pressure.
Without external shunts or transformer.	½ to ½ ½ to 1/5 1/5 to 1/20	2·0 2·5 4·5	1% full load or not less than 0·05 amp.	5% above or below.	1%	5% above or below.	1·0	25% for 1 hour. 30 times maximum current for 0·5 second.	100 to 50 lagging.	2·0 total error not to exceed 5·0.	If more than 1% per deg. C. Information on label.	Either normal or 10% above, the meter shall not register.	15% for 1 hour.
With external shunts or transformer.	½ to 1/5 1/5 to 1/20	2·5 5·0											

Variation of Pressure.—For each 5 per cent. above or below normal—additional error permissible—±1.0%.

Creep.—With normal pressure, or 10 per cent. above normal and the current coils disconnected, the meter must not register.

Variation due to Heating by Main Current.—The change in the rate of registration of a meter from the time the marked current is switched on to the time at which registration becomes constant, shall not exceed 2 per cent.

Excess Current.—25 per cent. for one hour, without injury.

ALTERNATING-CURRENT METERS.

The limits enumerated for direct-current meters, with or without shunts, also hold good for single and polyphase (balanced and unbalanced) meters, with or without transformers, on non-inductive load, together with the following additional limitations:—

Variation of Power Factor.—From 1.0 to 0.5 lagging—additional permissible error ±2.0%, provided that the total error of the meter does not exceed 3%.

Variation of Frequency.—5% above or below the marked periodicity. Permissible additional error ±1.0%.

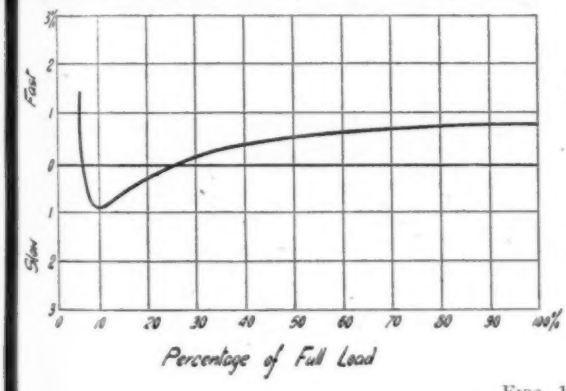
The limits stated include every possible operation on circuit, but do not cover accuracies on permanent overloads in the meters.

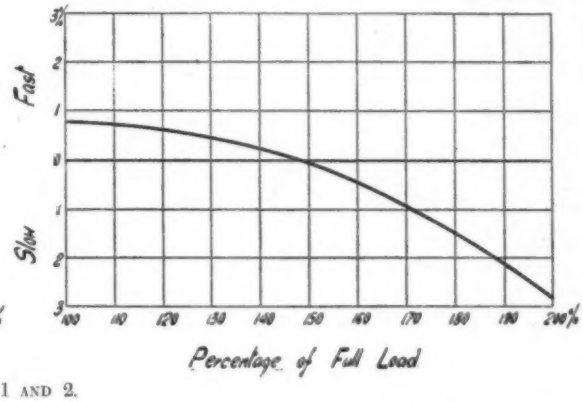
While it may be necessary, owing to unforeseen circumstances, to provide for installations in which accuracies must be guaranteed up to 25 per cent. overload, care should be taken so to gauge the possibilities of a circuit as to prevent at all times overload capacities exceeding this figure, and the tendency to conditions which call for meters being used beyond their rated capacity should be strongly opposed. It is far better to connect a meter in circuit whose rated capacity is between 25 and 50 per cent. greater than that of the circuit than to allow any overloading of the meter.

Consumers should not be allowed to connect subsidiary apparatus to the company's mains without previous notification, as all overloading of meters inevitably results in a loss of revenue.

In the U.S.A. accuracies at overloads of 50 per cent. are insisted upon with the sacrifice, in the case of d.c. meters, of accuracy at light load to compensate for better accuracy at the overload, while the limitations placed upon an a.c. meter make it difficult to obtain the accuracies demanded from 1/20 load to 50 per cent. overload.

Although the American rules demand a 50 per cent. overload, the tendency amongst American engineers has been to call for a 100 per cent. overload with an accuracy at that load which, if obtained, must inevitably sacrifice accuracies at light load. The curves, figs. 1 and 2, which are typical curves, show that there is a rapid falling-away of meter accuracy at overloads at 50 per cent. and upwards.





Figs. 1 and 2.

When a demand has been created for house-service meters with an overload capacity of 100 per cent., the following factors have to be considered:—

1. The capacity of the meter to withstand short circuits without mechanical or electrical damage.
2. The capacity of the meter to carry the current without undue heating.
3. The capacity of the meter to register within 3 per cent. on 100 per cent. overload.

While there is no great difficulty in fulfilling the demands enumerated in the three given points, and particularly that a meter shall register within 3 per cent. of accuracy on double load, it seems impossible, in the light of the full knowledge of an induction meter's capabilities, to avoid a falling curve from full load to 100 per cent. overload.

This means that where supply companies demand a 3 per cent. accuracy at 100 per cent. overload, they are asking for a meter which registers 3 per cent. slow at that load.

It has been stated in America that a 10-amp. meter is enough for ordinary lighting purposes, but that consumers install additional apparatus without advising the supply authority, so that the current consumption is liable to be as high as 20 amp., or even more; also that the percentage of consumers who do this is nearly 100, and that the meters installed are invariably 3 to 4 per cent. slow at double load.

If such conditions are known to exist, why is not the standard a 20-amp. instead of a 10-amp. meter?

Let us assume a hypothetical case in which cookers, radiators, &c., are used for two hours per day giving a maximum load on a 10-amp. 110-volt meter of 20 amperes, and compare that with a load for 12 hours of 1/20th the normal capacity of the meter.

The two-hour 20-amp. load $= 20 \times 110 \times 2/1{,}000 = 4.4$ kWh, and is generally registered on the meter running 3 per cent. slow. The 12 hours at 1/20 load $= 0.5 \times 110 \times 12/1{,}000 = 0.66$ kWh, and as the curve for an induction meter from 1/10th to full load can be regulated to 1 per cent. of absolute accuracy, we can ignore the loss from 1/10th to full load for comparative purposes; further, it is possible to regulate an induction meter to within 3 per cent. slow at 1/20th load.

Therefore, one day's consumption of energy under the given conditions $= (4.40 + 0.66) = 5.06$ kWh.

It will now be seen that the extremes of a meter's accuracy are very different in their degrees of importance, for 3 per cent. error at 100 per cent. overload $= 3$ per cent. of 4.4 kWh $= 0.132$ kWh, or nearly 3 per cent. of the total bill; and 3 per cent. error at 1/20th full load $= 3$ per cent. of 0.66 kWh $= 0.0198$ kWh, or 0.37 per cent. of the total bill.

Therefore, an error of 3 per cent. at 100 per cent. overload is approximately nine times as important as the same error at 1/20th load. Such being the case, it is not logical to use a 10-amp. meter for a 20-amp. load, for by so doing the revenue is decreased by approximately 3 per cent.

Fortunately, supply authorities in this country do not usually attempt to overload a meter or to call for overloads and accuracies at those overloads which must inevitably result in lost revenue.

The accuracy demanded of a meter in Great Britain is therefore as good as can be reasonably expected in an article which is made for commercial use in reasonable conditions.

3.—Testing Errors.

To obtain the accuracy demanded, a well-equipped testing department is necessary in order that the accuracy of a meter may be carefully gauged on receipt from the manufacturer and maintained during its life service.

It will be noted from the specification that the smallest permissible error is ± 2 per cent. Therefore the accuracy of testing instruments must not only be within this limit, but must also allow a certain margin for the "personal" error. A comparison of the accuracies demanded in the British Engineering Standards Association's specification for instruments shows that sub-standard instruments are the only type which can possibly be used to test meters within the guarantee laid down for them. Sub-standard instruments must comply with the following limits:—

(*a*) Voltmeters: Permissible error ± 0.2 per cent.

(*b*) Ammeters: Permissible error ± 0.5 per cent.

(*c*) Wattmeters: Permissible error ± 0.5 per cent.

Stop-watch errors should not exceed ± 0.5 per cent. when a reading of not less than 100 seconds is recorded.

Some authorities may look upon this error as too large, but when it is remembered that stop watches on meter test are continually being stopped and started, it will readily be seen that a smaller error is not practicable.

The above figures therefore show that the maximum permissible instrument-cum-stop-watch error for both d.c. and a.c. testing is from ± 1.0 per cent. to ± 1.2 per cent., depending upon whether ammeters and voltmeters or wattmeters are used.

A further error to be considered is the "personal" error. This is a quantity which varies with the type of tester employed, but with the average tester it will be in the neighbourhood of ± 0.5 per cent., while with an expert tester it may be possible to limit it to ± 0.25 per cent.

While the law of averages will preclude the probability of the maximum error being obtained, the possibility remains, and the need is emphasised for conditions and apparatus which will give limits of error within the limits of accuracy actually called for.

Another great danger in testing lies in using instruments below the point of efficient service. It is astonishing to find how careless in this respect many testers are in the use of their instruments, and that accuracies are expected which are not only not probable but impossible, for example:—

Consider an instrument of 100 equal divisions and assume the error to be 0.5 per cent. at a maximum scale reading (*i.e.*, at the 100 division point), and that the error per division remains constant throughout the scale. The following table shows how the error increases as the reading decreases:—

At a scale division of	Percentage error.	At a scale division of	Percentage error.
100	0.5	40	1.25
90	0.56	30	1.67
80	0.625	20	2.5
70	0.72	10	5.0
60	0.83	1	50
50	1.00	0	infinity

From the 30 division mark the error rapidly increases until at 1 scale division the instrument is actually 50 per cent. out. Yet cases are on record of tests having been taken at instrument scale divisions from 20 per cent. to 5 per cent. of the scale, and complaints have been received of the inaccuracy of meters whereas the meter has been correct and the tester at fault in using his testing instrument below the accuracy level. Under no circumstances should any instrument be read below 30 per cent. of the scale if accurate results are to be expected. A further important error to be avoided in reading test instruments is that due to parallax. This is dependent upon the angle at which the observer views the pointer in relation to its actual position on the scale, and may be the means of serious testing errors creeping in. The best type of testing instrument is provided with a strip of mirror under the pointer and along the inner edge of the scale. When the observer is in the correct reading position, the reflection of the pointer is lost to view by the observer, or the eye, pointer and reflection are in the same vertical line and parallax is avoided.

Sufficient has been written to show that the greatest care should be taken not only in the selection of the type of testing instrument, but also in the tester employed. It follows, therefore, if meters are to be accurately tested, that a well-equipped testing department should be installed; this is not only worthy of consideration, but is imperative if the accuracies called for are to be maintained; moreover, manufacturers' guaranteed accuracies can only be checked if supply authorities are sufficiently alive to the necessity of keeping their testing department in a state of efficiency.

Weekly checks should be taken on all testing instruments and no loophole left for inaccuracies to creep in. When a testing instrument shows a tendency to deviate from its normal reading, bi-weekly tests should be additionally taken in order that the apparent discrepancies may be traced to their source.

(To be concluded.)

ELECTRICITY IN NON-FERROUS METALLURGY.

Impressions of American Practice.

In the course of a lecture to the London Local Section of the Institute of Metals, at the Royal School of Mines, South Kensington, on November 8th, in which he gave some of his impressions of American non-ferrous metallurgy, Dr. W. Rosenhain, F.R.S. (of the National Physical Laboratory) emphasised the great extent to which electricity has been applied to various processes.

He referred first to the large plant for the electrolytic refining of copper at the works of the Anaconda Co. at Raritan (Perth Amboy). It was situated in the State of New Jersey and there were no exceptional facilities in the way of cheap power, &c. Copper was dealt with on an immense scale there. The crude metal reached the plant in the form of plates, which were used as anodes in the electrolytic refining process. The refining was carried out in an enormous number of cells operating simultaneously, large numbers of them being connected in series and grouped in parallel, and they covered literally acres. After being refined the copper was retained in the form of cathode plates, which were stripped and, as far as the greater part of them was concerned, were re-melted in furnaces. A number of by-products were obtained, including selenium and tellurium, as well as gold, silver, platinum, iridium, and molybdenum, and these again were carefully separated and refined. He believed that the recovery of the by-products had a good deal to do with the success of the whole operation.

After describing the various labour-saving and other mechanical devices adopted in copper and other metallurgical practice, and commenting on the fact that the keynote of American industry generally was production on an enormous scale, rendered possible by the thorough application of efficient methods and the use of scientific instruments—not so much because they were scientific instruments, but because of their labour-saving possibilities—he referred to the brass industry, the most striking feature of which was the extensive use of the electric melting furnace. The melting of brass in the electric furnace, he said, was not done exclusively, but it was rapidly becoming so. The brass industry was centred around Waterbury, Connecticut, but there were no natural sources of power in the neighbourhood, and electricity had to be generated from coal or oil, so that it was not particularly cheap. At first sight it was surprising that electricity was used so extensively, but actually it paid to melt electrically, the slightly higher cost of energy being counterbalanced by uniformity of working and product, and diminution of loss of metal by volatilisation, through complete avoidance of overheating. The Ajax-Wyatt induction type of furnace was used largely, and was rapidly ousting all others from the brass foundry. Only one man was employed to look after two furnaces and pour the metal direct into the moulds at perfectly regular intervals. The furnaces had to be worked day and night, because they must not be allowed to get cold, but that disadvantage did not appear to weigh heavily under American conditions. The Ajax-Wyatt furnace was not used for high-copper alloys, and he believed the reason was that the conductivity was wrong. Other electric furnaces were employed for those alloys. He rescribed an interesting process used for annealing brass tubes and for straightening them simultaneously. The tube was clamped at both ends into an electrical contact device. At one end the clamp was held rigidly, and at the other end the clamp slid on rails and had a weight attached over a pulley, which applied a slight tension to the tube. The heavy electric current passing through the tube, in addition to annealing it, made it soft enough to yield to the pull at one end, and it gradually straightened out. When it was stretched to precisely the right amount the movement of the clamp disconnected the current, the clamp was opened, and the tube fell out on to a grid, and passed on for inspection.

In spite of the marked depression of the nickel industry owing to armaments reduction, a remarkable new rolling mill for dealing with nickel had been installed by the International Nickel Co. at Huntington (West Virginia). It was entirely electrically driven and controlled, whilst also electric furnaces were used largely in the works. The rolling mill was manipulated from a bridge by two men working electric switches, and was a perfectly marvellous development of rolling mill practice.

On the general relation of science to the non-ferrous industries, Dr. Rosenhain said his impression was that those industries were very ready to avail themselves of scientific methods and appliances—more so than was the case in this country—but that, on the other hand, America looked to England for metallurgical research and did not contribute adequately to the advancement of the science. In that respect the industry lagged seriously behind others, such as the electrical industry, the great electrical companies having established research laboratories on a scale, both as regards equipment and staff, which was surprisingly large. England was looked upon to produce the knowledge, but they must admit that it was in America that that knowledge found its application mostly. At the same time, valuable scientific work was going on at the Bureau of Standards, Washington, but he

commented on the low salaries which were paid to research workers there, the effect of which was that trained men were attracted to industry because they could command higher salaries. Men in the colleges were booked up two years before the end of their curriculum, which would be a highly refreshing state of affairs if it existed in this country. Yet the colleges were crowded. Those who were engaged on research, however, were enthusiasts who devoted themselves to the work for the sheer love of it, but that state of affairs damaged the status of their whole profession. He urged, in conclusion, that they should make use of the results of their research, which had been used by others too long. He did not blame others for using them, but research was no use to them unless they developed it.

THE FYNN-WEICHSEL MOTOR.

The Wagner Electric Corporation, of St. Louis, U.S.A., has just announced the marketing of a new polyphase motor which presents interesting technical features and operating characteristics. It is stated that the machine has all the desirable features of the polyphase induction motor, such as large starting torque, ample overload capacity, and simplicity of design, coupled with a power-factor control which permits the designer, and if need be the operator, to adjust the motor's power factor to suit the most exacting requirements.

The new motor is a combination of a synchronous and an induction motor with a rotary converter, and may be designated as a "synchronous induction motor." The novel features are applicable to single-phase as well as to polyphase motors.

Synchronous motors are invariably built with defined polar projections and a large air-gap; induction motors are inseparably associated with extremely small air-gaps and a field structure without defined polar projections. Since the machine was to have the starting torque and the overload capacity of the induction motor, it was necessary to use a stator and rotor construction with an induction-motor air-gap. Having adopted this type of magnetic circuit, the first problem was to find means whereby it could be made to yield an acceptable weight efficiency when operated as a synchronous motor. The next was the necessity of providing means whereby the machine could be brought into step with a torque in excess of the full-load torque. There remained the question of automatic power-factor control within acceptable limits, and the elimination of the abrupt break-down of the synchronous motor known as "falling out of step." All of these requirements have been satisfactorily filled.

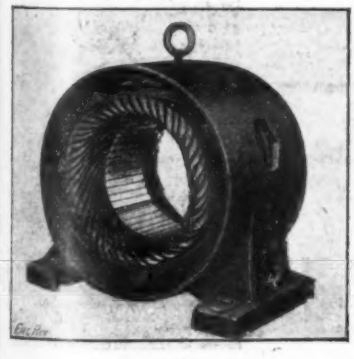


Fig. 1.—Stator.

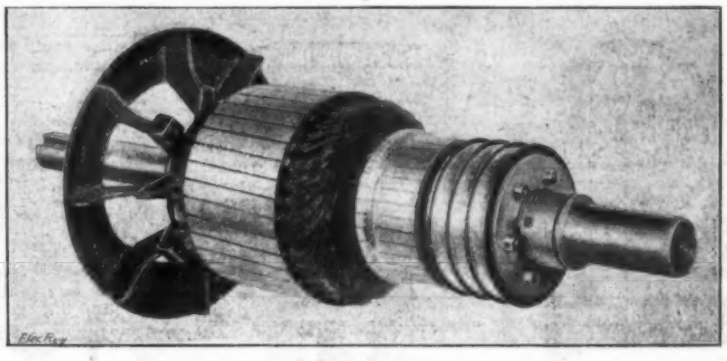


Fig. 2.—Rotor of Fynn-Weichsel Motor.

The machine as now built carries a primary winding on the rotor, connected to the line by means of slip-rings, and also connected to a small commutator. The stator is provided with starting and operating windings, the latter being connected to the commutator. To ensure good commutation, the commutator voltage is low. By this means, we are informed, it has been found possible to control the practically ceaseless motions of armature reaction axis, resultant field axis, and the vector of the terminal voltage with respect to the brush axis in what may also be described as a "self-excited synchronous induction motor." The stator and rotor are illustrated herewith.

The accompanying curves, fig. 3, represent the performance of one of the motors as now built; no adjustments of any kind were made during this test.

The machine starts exactly like an ordinary polyphase induction motor. It can be fitted with a squirrel-cage of high or low resistance, or with a winding in which resistances can be inserted when starting. Before the induction-motor torque reaches zero, an additional torque is developed; a value of 50 per cent. above the full-load torque is easily reached, and readily brings the motor into synchronism. The machine is held in synchronism by a suitable d.c. exciting current generated in the machine itself and until such time as the synchronous-motor part of the machine becomes overloaded. As the synchronous motor "breaks down," the induction-motor action automatically takes effect, and the machine continues to operate, as an induction motor. The transition is quite smooth, and when the overload is removed the motor quietly slips back into synchronous operation.

It is stated that the power factor can be adjusted to suit widely varying conditions; it can be made to hover near unity

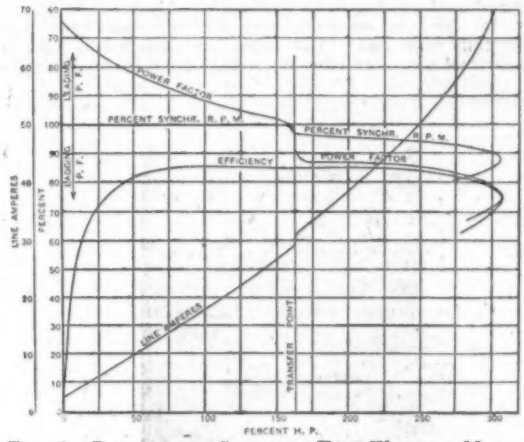


Fig. 3.—Performance Curves of Fynn-Weichsel Motor.

at all but the very light loads, say from one-quarter load up, or it can be set for unity at full load and made leading at all lighter loads.

As long as this machine operates at unity or a little below unity power factor, it works as a motor only, and at maximum efficiency. When it is adjusted to take leading current it does duty both as motor and as condenser, and thus performs a function which is generally done by special apparatus. The Fynn-Weichsel motor, we are told, can do duty as a condenser at all loads below the normal without sacrifice of full-load efficiency, and without overheating or complication of any sort. The weight efficiency of the motor is somewhat better than that of a corresponding polyphase slip-ring motor.

The motor was invented and patented by Mr. Val A. Fynn, Fel.A.I.E.E., M.I.E.E., an English engineer whose work in connection with a.c. motors is of world-wide reputation; he left this country some 15 years ago, and joined the Wagner company, but is now practising as a consulting engineer at St. Louis. The United States patents are owned by the Wagner Co., and the designs for this new line of machines have been prepared by the company's very able engineer, Mr. Hans Weichsel.

Miners' Safety Lamps.—Lieut.-Col. G. R. Lane-Fox, M.P., Secretary for Mines, announces that on October 27th, 1923, he made an Order under Section 33 of the Coal Mines Act, 1911, approving for use in all mines to which the Act applies, subject to the conditions specified in the Schedule to the Order, the following types of safety lamps: Patterson miners' electric hand lamp, type G. IA; "Kingsway II" pillarless electric hand lamp; Gray-Sussmann electric hand lamps, Nos. 5 and 6; "Ceag" shaft and roadway lamp, type B. The Order also amends the Schedules to previous Safety Lamp Orders with respect to the specifications of certain types of safety lamps already approved.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Falk, Stadelmann Fire.

A new three-bar series fire, which has been put on the market by Messrs. Falk, Stadelmann & Co., Ltd., 83-87, Farringdon Road, E.C.1, is illustrated in fig. 1. It is claimed that in this fire efficiency and attractiveness have been successfully combined. The refractory material is built in sections and bolted together with steel rods, thus minimising the possibility of mechanical damage. The body of the appliance is of heavy-gauge sheet brass, which is finished in a number of styles. The fire is provided with two switches, which are specially constructed to withstand the strain of foot operation.

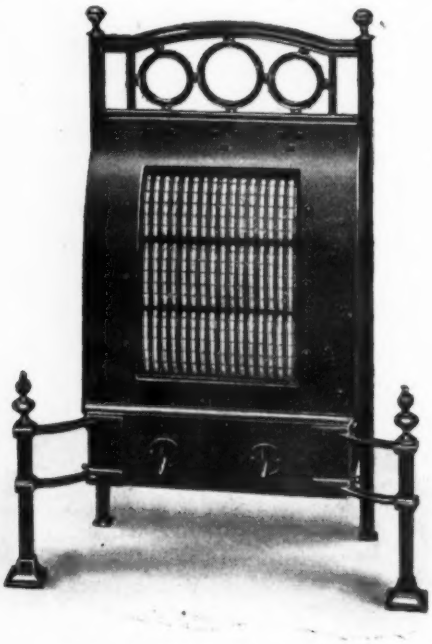


Fig. 1.—A New Falk, Stadelmann Fire.

The "Morris" Valve Template.

We have received a sample of the above-named device from Messrs. J. O. Nichol & Co., 46, Lancaster Avenue, Fennel Street, Manchester. It has been primarily designed for the amateur constructor of radio apparatus, and will stand a lot of rough usage. It is a simple and efficient tool, made of blue or dull-plated steel, which enables the holes for valve sockets or legs to be marked out quickly, accurately, and in one operation. The template is illustrated in fig. 2, and the manner of its use is as follows:—A mark is made on the panel where the centre of the valve is to be; the template is then placed on the panel and its centre located over the mark already made by means of the hole provided in the template. The arrow is next pointed in the direction in which the grid socket is to lie, the template is held down firmly, and tapped with a light hammer, when the four holes will then be marked ready for drilling.

Fig. 2.—"Morris" Valve Template.

Fig. 3.—The "Unique" Electric Grill.

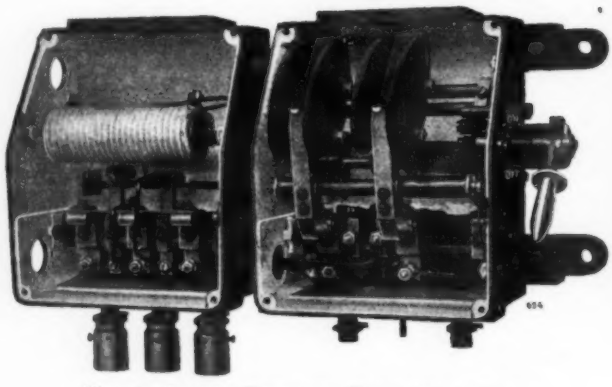


Fig. 4.—Ellison Panel for Three-motor Crane.

The "Unique" Electric Grill.

The Electric Heating and Hardware, Ltd., Crown Works, Berkley Street, Birmingham, is manufacturing a new pattern of grill (the "Unique"), which is illustrated in fig. 3. This consists of a stand, in the top of which is a swivelled plate containing the heating element. In the lower part of the stand a grilling pan is fitted; this can be adjusted in height by means of a number of rests in the sides of the stand. The body of the device is constructed of aluminium die castings and the pan is also of aluminium. By means of this appliance it is possible to boil water and keep food warm in the pan at the same time.

Relay Type Crane Control Panels.

Fig. 4 illustrates an example of relay-type totally-enclosed crane control panel, made by Mr. George Ellison, Perry Barr, Birmingham. This particular panel is designed for the control of a d.c. three-motor crane. The distinctive features of this gear are a large main, free-handle, overload, and no-volt circuit-breaker of ample size and breaking capacity; a small overload inverse time element relay in the circuit of each motor, to trip the main breaker when a motor is overloaded or fails; and the assembly of these elements as one compact unit which may be installed in any crane cabin without overcrowding. This method of employing only one circuit-breaker reduces the number of elements and the cost to a minimum, and increases the ease of manipulation. The breaker may be either double- or triple-pole as required. In the direct-current panels, the no-volt and shunt coils are connected in series, the no-volt coil is short-circuited by the relays or limit switches, and both coils therefore operate to trip the breaker. Various arrangements of the gear are possible. In the alternating-current type the no-volt and shunt trip coils are in parallel. The overload relays and shunt limit switches operate by closing the shunt trip circuit. The shunt limit switches are normally open. The time-lag device, which is an essential part of each motor relay, is a conical piston working in an oil-filled conical cylinder.

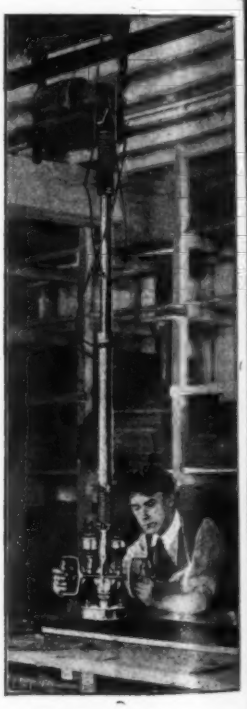


Fig. 5.—An Electric Polishing Machine.

An Electrically-driven Polishing Machine.

The patent polishing machine shown above, fig. 5, is claimed to be the only one of its kind extant. It is of English design and manufacture throughout, and is so simple and easy to manipulate that it can be used by practically anybody who is conversant with the elements of polishing. The device has interesting and novel features. Above the polishing bench, at a suitable height, is fixed a steel running rail, supported on brackets at convenient intervals, which, if required, can be

made to pass over the entire length of the polishing bench. From this rail is suspended an adjustable travelling carriage attached to a pair of tandem wheels running on ball bearings, thus reducing friction when moving to and fro on the steel rail. In addition, the entire carriage is capable of being swung at right angles to the direction of travel.

The carriage is a complete unit in itself, and consists of a ¼-h.p. electric motor, which drives the transmission shaft through a worm reduction gear, a cut-out, and a connecting box, all mounted on a substantial aluminium plate. The thrust of the worm is taken up by a suitable thrust ball-race, the whole of the driving mechanism being conveniently enclosed in a dust-proof metal case.

The transmission arrangement consists of a hollow telescopic stationary shaft suspended from the adjustable carriage, provision being made whereby the hand carriage carrying the polishing head, &c., can be locked off the work. Inside this shaft is a revolving shaft, also telescopic, provided with universal joints and thrust ball-races at either end, and driven by the motor on the adjustable carriage at a speed of 120 r.p.m.; this being in practice the most suitable speed at which to drive the revolving spindle in the hand carriage.

The hand carriage comprises two grip-handles, by means of which the operator can guide the grinding in or polishing pads to any part of the work. Between the handles are situated two glass containers for polish and spirits, the flow of each being regulated by valves controlled by thumb pressure: the polishing fluids are fed on to the pads through the centre of the revolving shaft. The containers can be easily removed and cleaned when necessary, and are provided with needle valves. The pads are attached to the end of the revolving shaft in the hand carriage through a ball joint. This is one of the most important features of the machine, as it enables the pads to be kept always parallel to the work, no matter in what position the hand carriage may be held. Two pad holders are provided, although any desired shape of pad can be fitted, and are locked in position by means of a spring bayonet catch. The first is known as a "beezing" or "filling-in" pad, and the second, which is used for "bodying-up," is furnished with a spring buffer plate, so that the pressure on the wood that is being polished can be regulated as desired by the operator. A switch on the hand carriage controls the motor, so that the machine can be immediately stopped and started as required.

By means of the universal joints at either end of the shaft a radius of 3 ft. from the centre of the work on either side is easily attainable, while the length-wise action is only limited by the extent of the running rail. All working parts are efficiently lubricated, and every part is standardised. The machine can be run off a lighting circuit, and when in motion there is no perceptible vibration.

The machine is made by the Delancey Tool and Engineering Co., Ltd., of 68a, Delancey Street, Camden Town, N.W.1.

THE BRITISH BROADCASTING CO., LTD.

A Supplementary Agreement.

A supplementary agreement* has been come to between the Postmaster-General and the British Broadcasting Co., Ltd., which modifies the company's licence dated January 18th, 1923. The new agreement provides that the term for which the company holds its licence shall be extended from December 31st, 1924, to December 31st, 1926, and that the licence shall cover any stations which the Postmaster-General may authorise in excess of the eight originally arranged for. Also that the company shall not without the consent of the Postmaster-General receive money or any valuable consideration from any person in respect of the transmission of messages by means of the licensed apparatus:

Provided that nothing in this clause shall be construed as precluding the company from (1) broadcasting matter provided gratuitously by any person with or without an acknowledgment of such provision by means of the broadcasting service; (2) receiving a consideration for broadcasting names of publishers and prices of matter which is broadcast; (3) receiving a consideration for broadcasting commercial information approved for broadcasting by the Postmaster-General, subject to such conditions as he may prescribe; and (4) (so far only as the licence of the Postmaster-General is required) from using for broadcast purposes without payment concerts, theatrical entertainments, or other broadcast matter given in public in London or the Provinces.

The company may work any of its stations at any hour of the day or night on any day of the week, including Sunday, but shall comply with any requirements of the Postmaster-General to discontinue working in order to avoid interference with Government stations or with any other undertaking licensed by him.

Transmission by means of the licensed apparatus shall (except with the consent of the Postmaster-General) be only on the wave-lengths of from 300 to 439, and from 461 to 500 metres.

*Cmd. 1,976. H.M. Stationery Office. Price 6d. net.

Clause 22 of the principal agreement shall be modified to admit of dealers who deal in wireless apparatus for use in connection with the broadcast scheme, exclusively of British manufacture, becoming members of the company, but the latter shall not require members joining after the date of the new agreement to deposit the £50 referred to in the original members' agreement and shall refund the deposit to existing members who have already paid it.

The sums payable under Clause 4 (*d*) of the original members' agreement to the company shall be modified as follows:—

	s.	d.	
On each crystal set	1	0	
On each microphonic amplifier without using valves	5	0	
On each crystal set and one valve... ...	11	0	
On each crystal set and two valves ...	18	6	
On each one-valve set	10	0	
On each two-valve set	17	6	
On each set adapted for more than two valves a further sum for each additional valve holder of	5	0	
On each low-frequency valve amplifier ...	5	0	per valve holder.

No sum shall be payable on telephone earpieces, loud-speakers, and valves.

The company shall secure upon the board of directors such additional representation of manufacturers and (after they have become eligible for membership of the company) of dealers as the Postmaster-General and the company have agreed.

There shall be two forms of receiving licence, *i.e.*, (i) a broadcast licence (10s. per annum), allowing the use only of complete sets, and amplifiers (valve or otherwise), telephone head receivers, loud-speakers, and valves which bear the company's trade mark; and (ii) a constructor's licence (15s. per annum) a condition of which is that the licensee must construct his apparatus himself and must not knowingly use any but British-made parts. After January 1st, 1925, the Postmaster-General may discontinue the issue of two forms of licence and substitute one type only, which may cost 10s. annually and be free of conditions. The clause in the principal agreement relating to the grant of licences for experimental or commercial purposes is confirmed. (The issue of "interim" licences was discontinued on October 31st, 1923.)

Of the 10s. licence fee 7s. 6d. is to be paid to the company and of the 15s. licence fee 12s. 6d.

If the income of the company from all sources during the extended period shall be more than sufficient to meet such expenditure as the Postmaster-General shall in consultation with the company consider reasonably adequate to provide a broadcasting service, to provide a reserve fund to meet depreciation and obsolescence, and to pay 7½ per cent. per annum on the company's subscribed capital, the proportion of each licence fee shall be reduced and any surplus income shall be surrendered to the Postmaster-General.

Provided that the company supplies a satisfactory broadcast service and erects additional stations where the Postmaster-General may reasonably consider them to be necessary within a reasonable time, the Postmaster-General will not prior to January 1st, 1925, grant a licence to any other person to broadcast in Great Britain. In the event of his licensing another person he shall withhold from the company the sums to which it would otherwise have been entitled in respect of licences issued after the commencement of a regular service by the new undertaker to persons within the latter's area, the limits of which shall be based on the receptive capacity of an ordinary crystal set.

The Postmaster-General also reserves the right during the extended period to grant licences to any person other than the company to carry on services, additional to those carried on by the company, whenever he may consider them desirable without withholding from the company any part of the sums to which it may be entitled.

The Influence of Magnetism on Life.—Experiments have been carried out by Messrs. F. W. and F. C. Lee at the Johns Hopkins University, to determine whether a rotating magnetic field had any effect upon the growth of a living organism. Trout were hatched from eggs immersed in the rotating field, but after 45 days, when all the eggs had hatched, no difference was observed between the fish thus produced and those hatched under control conditions, nor was the hatching time altered. Other organisms were tested, including bacilli, but always with negative results. Describing their work in *Science*, the authors conclude that in the case of growth matter is composed of atoms of which the electrons are in a state of static equilibrium.

New X-ray Installation.—New X-ray apparatus has just been installed at King's College Hospital, London, at a cost said to be £1,500. The new outfit will be used exclusively for the treatment of malignant growths.

LEGAL.

O'Driscoll v. Marconi's Wireless Telegraph Co., Ltd.

In the King's Bench Division, last week, Mr. Justice Bailhache concluded the hearing of the action brought against Marconi's Wireless Telegraph Co., Ltd., by Mr. Florence O'Driscoll (*vide* our last issue, p. 691).

Plaintiff in evidence said that the post as manager for *The Times* in South America, which he relinquished to join the defendants, was estimated to be worth at least £5,000 a year. In his view there was no valid reason why the defendants should not have built the station in 1919 and 1920.

Asked why he refused the offer of £3,500 a year for further employment over three years, Mr. O'Driscoll said the difference between Mr. Isaacs and himself was one of principle and not of figures. Mr. Isaacs's view of commercial morality and witness's view were totally different. Witness would not associate himself with what he looked upon as an attempt to rob the Argentine shareholders.

In cross-examination plaintiff said the Argentine company dare not make a call on the shares. Nothing had been done by the company for six years and the directors went to the meetings with revolvers in their pockets. If they had made a call upon shares the whole business would have fallen through.

Mr. O'Driscoll was asked whether the cost of erecting a four-way station would have been about a million pounds. He replied that, in his opinion, the cost would have been considerably less. He denied that under the consortium agreement the benefits obtained by the London company would have gone into the pockets of the Argentine shareholders.

Mr. Bevan, K.C., for the defendants, submitted that there was no case for the defendants to answer, but his Lordship intimated that he desired to hear the defence.

Mr. Godfrey Isaacs, managing director of the defendant company, told the Court that the English company had retained a controlling interest in the subsidiary Argentine company. The proposal to erect the station was suspended during the war. After the war it became obvious that the old proposition would not prove of much value. The Ambrosetti installation was not a sound commercial proposition for the Argentine in 1918. It was a fact that stations which had been developed by 1918 supplying the deficiencies of the Ambrosetti station cost substantially more. At the present moment the defendants intended to erect a similar station in this country at a cost of approximately £600,000. The erection of such a station in the Argentine would cost rather more than less, due to the larger amount of land required.

Mr. Godfrey Isaacs, in the course of his cross-examination, objected to the suggestion made throughout the case that the defendants had sold themselves to the Germans. He explained that the company was originally a German one. It had now been converted into an international company, in which the Americans, French, Germans and English participated equally, and had an equal voice in the management of the station. Their original scheme would have proved an absolute failure. Witness admitted that they might have completed the station by 1914 if they had started in 1912. The station now working in part had taken three years to erect, and was not yet complete. The new station was using the Marconi system in part. They were using a system based upon the best of the American, French, German and English inventions. It was true that the Argentine company had secured the Marconi patents for South America, and in handing those patents over to the new company, the defendants had taken a risk pending the Argentine company's ratification of the agreement. Mr. Isaacs could not agree that the Argentine shares had been rendered practically worthless by reason of the consortium arrangement. They would become worthless if the defendants were able to put an end to the litigation with which they were threatened by the Argentine company.

At this stage his Lordship inquired whether it was yet possible for the parties to come to some settlement. A consultation followed, but after an adjournment, Sir Henry Maddocks intimated that the efforts to arrange a settlement had proved unsuccessful.

His Lordship, in giving judgment, said that in relinquishing his appointment with *The Times* and taking the appointment offered by the Marconi company, Mr. O'Driscoll was no doubt greatly influenced by the option he had to a call upon 10,000 shares at 10s. per share. When the consortium agreement was proposed he had many objections, but his Lordship was quite satisfied that the reason why the plaintiff declined the alternative offer made to him was that the defendants offered an agreement for three years whereas he was standing out for six years. On the assumption that the plaintiff was employed by the defendants—which was the only assumption on which the plaintiff could succeed—it was quite clear he dismissed himself. He suffered no damage because the new terms were considerably better than the old ones. That fact had defeated his claim even assuming that he was in their employ.

There remained the question of the promise to a call upon the Argentine shares. His Lordship did not consider that that question was inseparable from the other terms of his employment. The 10,000 shares were open to him at any time that he liked to buy them. But what was wrong with the option was that the value of the shares was nothing like the value that the plaintiff hoped they would have reached by this time. The reason for that, in all probability, was that the high power station which was contemplated had been abandoned, and in its place was the station resulting from the consortium arrangement. His Lordship said he was satisfied that in entering into that arrangement the defendants had not the smallest intention of injuring the plaintiff at all. They entered into the arrangement for what they considered were good business reasons. The defendants thus refrained from building their station, and did not intend to injure the plaintiff's right to call for the shares. For those reasons the action failed, and would have to be dismissed, with costs. His Lordship expressed his regret that Mr. O'Driscoll, against the counsel of his legal advisers, but that day refused a very generous offer made to him by the defendant company.

Judgment was accordingly entered for the defendants with costs.

Weston Electric Lamp Co. v. Parry.

In the Shoreditch County Court, on Tuesday last week, before Judge Cluer, the Weston Electric Lamp Co., of 1-3, Sun Street, Finsbury, E.C., sued Mr. H. H. Parry, of 47, Coedoe Road, Abertridwr, near Cardiff, to recover £15 12s. 6d. for goods supplied. The defendant had filed an affidavit—he was not present in Court—to the effect that he was an agent of the plaintiffs, and was entrusted with supplies of electrical fittings to the value of £25 1s. 10d. Then he was asked if he would return them for the purpose of an audit and he duly dispatched them with the exception of five "Astro" reflectors and five shades, value £1 4s. 9d., which he brought into Court.

Judge Cluer gave judgment for the amount claimed.

Passing-Off Action.

Mr. Justice Tomlin, in the Chancery Division on Friday, had before him a motion in the action Hoover, Ltd., *v.* W. Douglas, of Chancery Lane.

Mr. Sebastian, for plaintiffs, said the motion was to restrain a passing-off. The defendant, who had consented to a perpetual injunction, had advertised Hoover pattern electric sweepers at approximately a fifth of the price of Hoover sweepers. The plaintiffs were not asking for damages.

Defendant said the advertisement was not issued by him.

His Lordship granted the injunction as asked.

Standard Glass Co. v. W. Sitch & Co., Ltd.

In the Shoreditch County Court, on November 8th, before Judge Cluer, the Standard Glass Co., New North Road, N., glass merchants, sued Messrs. W. Sitch & Co., Ltd., electrical fitting manufacturers, Berwick Street, Oxford Street, W., to recover £5 7s. 6d., balance of an account of £183 7s. 6d., for glass electric globes supplied. The defendants denied liability beyond £1 11s. 6d., which was paid into Court. Plaintiffs said that the glass globes were ordered by the defendants' managing director on August 22nd, 1921. The order was for a gross at 22s. 6d. each, but they made 163 and delivered them and they were accepted, no complaint being made as to the quantity. They received £10 from the defendants but then had difficulty, so on December 31st, they wrote threatening proceedings unless the account was settled. A reply was received referring them to Mr. Hayward, of 6, Broad Street Place, the receiver to the defendant company. Plaintiffs saw Mr. Hayward on January 1st, 1922, obtained £20 from him, and then from time to time further sums leaving the balance sued for due.

A defence had been set up that £3 7s. 6d. was to be allowed, but plaintiffs alleged that that agreement was obtained by misrepresentation. They agreed to take £25 a month, but they had found out that defendants had been paying out money recklessly, instead of paying this account. Judge Cluer: But the receiver pleaded bad trade, and you made the arrangement with him, so I think you will have to allow it. It is perhaps little known to business men, that they can come to an arrangement with a debtor to settle say £100 for £90, but directly after having received the £90 can sue for the odd £10. Such a settlement is not a legal settlement, and is 200-year old law. It is probably bad law, but it has been upheld by the House of Lords. If you want to come to such a settlement legally, there must be a consideration for the balance. The defendants owe only £1 11s. 6d., and this has been paid into Court, so there must be judgment for defendants with costs.

British Thomson-Houston Patents.

Mr. Justice P. O. Lawrence, in the Chancery Division, on November 9th, concluded the hearing of an action by the British Thomson-Houston Co., Ltd., against J. M. Webber and Co., Ltd., incandescent lighting specialists, of Great Eastern Street, E.C., for an injunction restraining an alleged infringement of plaintiffs' letters patent 23,499 of 1909, "for improvements in and relating to the treatment of tungsten to facilitate working." The infringement was denied by the defendants.

Mr. C. Terrell for the defendants, asked for an adjournment until after the trial of an action set down for hearing by Mr. Justice Russell, in which the validity of the plaintiffs' patent was attacked. Counsel stated that the British Thomson-Houston Co. had brought 100 actions against a number of people, many of whom were not in a position to go to the expense of fighting the validity of the patents. In this case, the defendants were merely purchasers of the lamps and did not know how they were manufactured. He submitted that the numerous actions against little users should be postponed until the substantial fight had been decided.

His Lordship said that this action had been in the warned list for ten days and now when it came on for trial he was asked to postpone it because another case was coming on, which raised the question of validity which was not raised in this action. It would not, in his opinion, be right in the interests of the plaintiffs or of the public to entertain such an application.

Mr. Courtney Terrell said that under the circumstances he must submit to an injunction, but asked that it should be limited to the lifetime of the patent.

His Lordship granted the injunction asked for limiting it to the life of the patent and made an order for the delivery up of the infringing articles and an inquiry as to damages.

The British Thomson-Houston Co., Ltd., were plaintiffs on a motion for judgment in default of defence in an action for infringement of patent against the Princess Electrical Co., which came before Mr. Justice Tanlin in the Chancery Division on Tuesday.

Mr. Tolver Watson, for plaintiffs, said the defendants sold twelve 200-volt, 60-watt incandescent electric lamps which infringed the plaintiffs' patents. They were marked with the word "Princess."

His Lordship granted the relief asked for, *viz.*, a perpetual injunction restraining infringement, and delivery up or destruction on oath of the infringing articles.

British Thomson-Houston Co., Ltd., v. British Insulated and Helsby Cables, Ltd.

Important Patent Action.

Mr. Justice Russell, in the Chancery Division, on Tuesday, November 13th, commenced the hearing of an action brought by the British Thomson-Houston Co., Ltd., against the British Insulated & Helsby Cables, Ltd., of Prescot, Lancs., for an injunction to restrain defendants from infringing letters patent, No. 23,499, granted to plaintiffs in 1909 for an invention for improvements in and relating to the treatment of tungsten to facilitate working. Plaintiffs alleged that defendants had imported or manufactured lamps, the filaments of which infringed plaintiffs' invention. Defendants denied the infringement.

Sir Arthur Colefax, K.C., Mr. Hunter Gray, K.C., Mr. Whitehead, K.C., and Mr. Trevor Watson appeared for plaintiffs, and Sir Duncan Kerly, K.C., Mr. Courtney Terrell, Mr. S. Cripps, and Mr. Corsellis for defendants.

Sir Arthur Colefax stated that the usual defences to the action were raised, namely, non-infringement and invalidity of the patent. As to invalidity, the issues raised were want of novelty, subject matter, and utility, and also insufficiency. The plaintiffs' patent was for an invention which was concerned with the production of a body of mechanically worked tungsten which was ductile at ordinary temperature. The use or practical application of the invention was the production of the filaments for practically all the incandescent lamps in use to-day, and certainly the filaments of all those which were in fact composed of tungsten. Tungsten was a powder obtained by reduction by one of three methods, namely, reducing the oxide of tungsten by hydrogen, carbon, or zinc. Tungsten was a highly refractory powder, and even to-day it was impossible to melt the powder and thereby obtain an ingot of pure fused tungsten. The reason for this was that the melting point of the metal was 3,900 degrees Centigrade. To melt the powder a container would, of course, be necessary, and nothing would withstand such a temperature unless it was a carbon crucible. If such a vessel were used, carbon combined with the tungsten, and the ingot obtained would not be pure tungsten. In addition to its high melting point, it also had two other properties, namely, a high specific electrical resistance and a low vapour tension. As far back as 1889 it had been stated that these properties rendered the metal, if it could ever be used, a most desirable material out of which to make the filaments for incandescent lamps. Up to the date of plaintiffs' patent, tungsten was only known as a brittle metal, and it had certainly never been obtained ductile at ordinary temperature. Plaintiffs' patent related to an invention by an American, Doctor Coolidge, who had been working for some time to devise a method of drawing tungsten, and by 1909 he had solved the problem. The filaments were first put on the market in 1911, and they had entirely displaced all other tungsten filaments.

The hearing was adjourned.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

An American Station on One Valve.

You may remember that some months ago I excused my failure to write up a subject which you had suggested by saying that I was severely bitten by the wireless craze, and was devoting all my energies to getting "W J Z on a cat's whisker." I have not succeeded in doing that yet, but I have, I think, managed to break a record in wireless reception.

At about 10.5 on the evening of the 6th I heard America on one valve. I know that similar claims have been made by others, but (speaking from memory) they have all been experimenters juggling on the brink of oscillation with super-regenerative circuits, or with the adventitious aid of crystal detectors and dual amplification. What I believe constitutes a record in my case is that I was using an absolutely standard B.B.C. model (one of Mann, Egerton & Co.'s "Mecophones"). True, the circuit embodied in it is an unusual one, but it is truly a one-valve circuit, without crystal or l.f. transformer, and one that has been passed by the P.M.G. for use on an out-door aerial.

I do not know the station I got. It was a little higher than Cardiff—which I was tuning in—probably about 355 metres. Unfortunately I happened on only the concluding words of an address. I quote them, to support my claim to veracity, if not to a record:—

"..... I shall undoubtedly win in the second round. Hello, Boston! Hello. (Some name I did not catch.)....."

And then apparently the station closed down. An interesting fragment of Yankee self-confidence delivered in a heavy nasal voice. The strength and clearness were about equal to those of an average trunk call of about 100 miles land line.

I was fortunate in stumbling on the station at the time I did, as I confess I have not the fortitude to sit up till, still less to get up at, the unholy morning hours when American transmissions are usually received. The conditions presumably so early in the evening as 10 o'clock are less favourable on the American side. This, and the satisfactory strength at which I received the transmission, encourage me to prophesy that, within a few months, with the aid of similar sets and a good aerial, my experience will be common enough.

J. S.

Norwich, *November 7th*, 1923.

The Postmaster-General and Electrical Power and Lighting Undertakings.

On reading the editorial comment in your issue of November 2nd I decided to retire from the conflict, turning my back even on the tempting bait of Mr. Fennell's letter of the same issue. I cannot resist, however, Mr. Stoker's letter in your issue of November 9th, and I hope you will bear with me to the extent of a few more words as I particularly want to call attention to a new and misleading statement in that communication.

Mr. Stoker raises a fresh hare in the following:—

"I would like to draw attention to the fact for what it is worth, that in the model clauses inserted in Railway Acts authorising the use of electrical power the section requiring undertakers to so construct their electric lines and works and work their undertakings as to prevent interference with the telegraphic lines used by the Postmaster-General is qualified by exclusion of any telegraphic line of the Postmaster-General laid down or placed by him along the railway."

Anyone reading this would naturally think that a railway company need not take precautions to prevent injurious affection to the Postmaster-General's telegraph lines placed by him along the railway. This would be inaccurate. In the very same model clauses referred to by Mr. Stoker there is one dealing with such lines, and it reads:—

"2. And the following provisions shall have effect in respect of the telegraph lines of the Postmaster-General laid down or placed on or along the said railway:—

(a) The company shall construct their electric lines and other works of all descriptions and shall work their undertaking in all respect with due regard to such telegraph lines and the current in such telegraph lines, and shall use every reasonable means in the construction of their electric lines and other works of all descriptions and the working of their undertaking to prevent injurious affection whether by induction or otherwise to such telegraphic lines or the currents therein. Any difference which arises between the Postmaster-General and the company as to compliance with this sub-section shall be determined by arbitration."

The difference between the two clauses is that in one case, *i.e.*, for lines off the railway, the protection is *absolute*, whilst in the other case, *i.e.*, for lines on the railway, it is qualified to the extent of being a subject of arbitration.

F

On technical matters Mr. Stoker is admittedly at the mercy of those furnishing him with information, but I feel in the above matter he has not fairly represented conditions which should have been known to him.

On the other points I will say little: I have re-read and have asked others to read Section IV of the Electric Lighting Act, 1888, and neither I, nor they, can see how it applies to *Statutory* undertakers. This may not be extraordinary, as I am not a lawyer, but my reading has been confirmed by a legal friend; but this in turn may not carry it much further, as even lawyers differ.

As regards the 20-volt drop on the uninsulated rail of the Brighton Railway, I think it can be taken that no such limit was fixed by the Board of Trade, and the reason for this may have been associated with the question: what is intended by stipulating such a drop, and how is it to be measured? The current in the contact wire being alternating, inductively produces voltages, not only in the rails and neighbouring pipes, but also in the leads which would be used for measuring the p.ds. between two points. The current produced in this way in the measurement circuit would be nullified to a certain extent by the return current in the rails, and although the measurement might be effected by running the leads at right angles to the track for some distance, the resulting figures would need definition.

But, after all, these points have very little bearing on the matter raised in Mr. Stoker's original article, which was concerned with what was stated to be the arbitrary action of the Postmaster-General in objecting to the use of a high-pressure main with one conductor only, and using the earth as a return. You, Sir, supported Mr. Stoker to the extent of stating that the "Post Office has no case against the use of the earth on technical grounds," and dismissed evidence of what happened when Dr. Ferranti did such a thing as "trifling with the matter," apparently on the ground that it occurred in the eighties of the last century. Surely the laws of electricity governing inductive effects have not changed in the meantime! Might I also suggest that if there are no objections to the use of earth returns the following would not be included in the "Reports of Joint General Committee of the National Electric Light Association and Bell Telephone System on physical relations between Electrical Supply and Signal Systems":—

> "*Ground Return Circuits.*—Ground return circuits or ground return branches of multi-wire supply circuits should not be employed. This does not apply to track return circuits."

This rule is given in the section "Principles and practices for inductive co-ordination of supply and signal systems." I think it can be taken that if on economical or other considerations earth returns were a feasible proposition they would have been adopted extensively in the U.S.A. Neither there, nor in this country, have such proposals been put forward by responsible authorities.

I will not add to this "war of words" by replying fully to Mr. Fennell's letter in the issue of November 2nd, but I really must draw attention to the inaccuracy in his dogmatic reference to the inductive effects of a high-pressure line. He says: "A line was objected to on the ground that, *being high pressure*, it might cause interference with a Post Office line parallel to it on the opposite side of a wide public road. The officer concerned seems to be unaware that the pressure has no bearing on the subject except in the opposite sense to that imagined by him, *viz.*, by reducing the current and, therefore, the induction. Here we have a proof of the lack of accommodation of the Post Office." Static inductive effects are usually much more serious than electromagnetic effects where telephones are concerned, and this is well known to those conversant with the subject. Mr. Stoker implies in his letter that I have taken umbrage at what has been said. I did not realise that it had affected me to that extent, but if it has it must be attributed not to the legal questions raised, but to the challenging of the technical position of the Post Office on such slender evidence.

In conclusion, may I assure Mr. Stoker that I at least in this department have never considered myself to be "an infallible angel," and I am sure he would not have fallen into that error had he known me personally. I am not a bit like an angel.

S. C. Bartholomew.

Engineer-in-Chief's Office, G.P.O.,
London, *November 13th*, 1923.

I have no wish to enlarge on this discussion, but I think that one of the statements in Mr. Fennell's letter in your issue of November 2nd, should be questioned.

Mr. Fennell says: "A line was objected to on the ground that *being high pressure* it might cause interference with a Post Office line parallel to it on the opposite side of a wide public road. The officer concerned seems to be unaware that the pressure has no bearing on the subject except in the opposite sense to that imagined by him—namely, by reducing the current and, therefore, the induction. Here we have a proof of the lack of accommodation of the Post Office." Is it not a fact, Sir, that static inductive effects are usually much more troublesome than electromagnetic inductive effects? I believe that Mr. Frank Gill proved this many years ago, and I understand that it is generally accepted by telephone engineers that high-voltage rather than current effects cause the greatest trouble. Unless, therefore, Mr. Fennell is an authority on the subject, I do not think his statement should be accepted without inquiry.

A. J. S.

November 6th, 1923.

Working Conditions in America.

With reference to correspondence in your paper from "Erimus" (October 12th issue), and J. R. Evans (October 19th) regarding the conditions and prospects of electricians and engineering graduates in the U.S.A., may I state that the conditions are good?

The wages paid to electricians are: New York City, $1.25 per hour; this and other smaller cities $1.00 per hour. Armature winders get about the same rate. A city licence must be obtained, which would not be difficult to get. Hours are generally from 8 to 5, or the equivalent.

Engineering graduates are in demand, getting preference over others. Prospects for these men are good too, because promotion depends upon the man himself here much more than in England. Push is necessary, backed by brains.

Living conditions are much better than in England, as a man is able to buy his own house and have a car on ordinary wages. Rents are high, taking from about 25 to 40 per cent. of the wages; for instance, a flat or one-family house rents from $40 to $60 a month. Foodstuffs are approximately the same price as in England.

Just at present there are signs of a depression coming—such as usually occurs during the time of a Presidential election. This is evidenced by orders slacking off quite a lot lately. But no man who can work need be out of work here for more than one month, even when trade is bad!

I trust the above will be of use to anyone considering coming over here.

Charles M. Whitfield.

Schenectady, N.Y., U.S.A., *November 2nd*, 1923.

[We are much indebted to our correspondent, who further informs us that he will gladly give what further details he can to anyone who cares to write to him at 3, Wilson Avenue, Schenectady.—Eds. Elec. Rev.]

Single-core Cables on Three-Phase Systems.

In your issue of November 9th, on p. 689, there appears a short article on the use of single-core cables on three-phase systems. In the preparation of this article, the author seems to have made very considerable use of the paper on the same subject appearing in the *Journal* of the Institution of Electrical Engineers, Vol. 61, No. 317, p. 477; for, not only are the conclusions arrived at in the article identical, except in one respect, with those given on p. 483 of the *Journal*, but also the very terms "sheath eddy" and "sheath circuit eddy" have been adopted from p. 477.

We do not, of course, complain of this apparent plagiarism, although if our surmise is correct we think that it would have been courteous to have acknowledged the source of the information; but we do object to the suggestion that sheath circuit eddies can be eliminated in modern practice by insulating the glands of the cables from the dividing boxes. Such a plan would naturally occur as the first possibility to anyone who had given thought to the matter, but on reflection he would remember that all the sheaths and all the dividing boxes have usually to be earthed through substantial connections, so that a return path for the sheath circuit eddies is unavoidable—unless a complicated arrangement were adopted in which the cable sheaths were only earthed at one point for each cable. This, however, in our view, is not only impracticable but undesirable, for at any point remote from that selected for the earthing, there would then be a p.d. between the cable sheaths which would be quite sufficient in some cases to give a very smart shock to any workman who was called upon to handle them.

We do not, in fact, see any practicable means of eliminating the sheath circuit eddy by any system of special isolation of the sheaths.

William Cramp,
Nora J. Calderwood.

The University, Birmingham,
November 12th, 1923.

Wireless Apparatus.

Your correspondent "Contractor," whose letter drawing attention to the inadequacy of trade discounts allowed to retailers of wireless apparatus appeared in your issue of the 2nd instant, may be interested to learn that our committee have for some time past been pursuing inquiries in this connection, and that they invite all dealers to communicate their views on the subject to them. For the purpose of facilitating their efforts on behalf of the retail trade and obtaining the widest expression of opinion, the committee have issued a form, providing spaces for answers to certain specific questions, which may be had on application to the Wireless Re-

tailers' Association, 70, Finsbury Pavement, London, E.C.2. The use of the form, however, is not essential, their main object being to secure the views of as many legitimate retailers as possible on this supremely important question, so as to give the greatest weight to any measures they may find it desirable to take.

Clifford & Clifford,
Hon. Secretaries,
The Wireless Retailers' Association.

London, *November 13th*, 1923.

Local Exhibitions: Glasgow.

With reference to your notes in this week's issue, I would like to draw your attention to the manner in which the above Corporation's Sales Department secures its success. As soon as an intending consumer signs the application form for a supply, the form, before even it is acknowledged as being accepted, is handed to the Sales Department, which immediately sends out its circulars calling attention to fires and cookers; also a salesman calls in a few days to book the order. This practice, if carried out by a wholesale house, would be considered, to say the least of it, sharp; and also does not give the contractor, who has done the spade work by securing the order for the installation, a chance to sell his fires, and ought not to be allowed.

A Contractor.

November 6th, 1923.

Small British Motors Wanted.

I thank you for your letter of yesterday enclosing correspondence.

The number of letters and callers since the appearance of my letter in your journal is somewhat overwhelming. We are dealing with them as quickly as possible.

It is evident that the difficulty is in requiring an induction repulsion motor, and with a few people that the larger motors are required to start on a snap switch.

Please accept our thanks for the valuable assistance rendered to us in this matter.

F. Patrick.

Leeds, *November 8th*, 1923.

Telephone Licence.

A licence or certificate for the use of telephones recently came into my possession which dates back to 1875, and I have been wondering whether this is of interest, as it is the first of its kind I have seen, and I have no doubt there are many at present engaged in the electrical trade who have never seen anything of the kind, as it shows what had to be done in the early days of telephone work before a party could use even private telephones.

The enclosed copy is of the wording on the printed agreement, and I am forwarding you this as an item of news which you are open to use if you consider it of interest.

I have personally made inquiries of various gentlemen who have been in the electrical trade many years, and I have not been able to find one who has a similar agreement and licence to use telephones, nor have they seen one, hence my thought that it might be of interest.

H. Moss.

Bradford, *November 6th*, 1923.

[Copy.]

THE TELEPHONE.

SALE.

Articles of Agreement and Licence to Use.

The General Agent for Professor Alexander Graham Bell's Articulating Telephone hereby agrees to sell, and James Davis, of 51, Tyrrel Street, in the town of Bradford, County of York, hereby agrees to purchase Two Telephones.....

.....

.....

.....

with the right to use the said apparatus for Lecturing and Exhibiting purposes at .....

.....

.....

in the counties of York and Durham and in no other place, and for no other purpose, except and by the approval and under the sanction of the said General Agent, to be expressed in an Agreement to be granted for that purpose, for a sum of Twenty-Three pounds sterling. Less 15 per cent.

The said apparatus shall become forfeit to, and the property of, the said General Agent, should not the terms of this agreement be observed.

The General Agent shall afford the said James Davis all reasonable power to employ the said apparatus for purposes of a similar character to that specified in this agreement by the execution of fresh agreements at a nominal charge of £1 each for registration, notification, &c., and the said James Davis shall afford the General Agent or his representative every facility for tracing the employment and the uses to which the said apparatus is applied, and shall, on the request of any such authorised person, refer the same to this document as the authority under which the said apparatus is employed.

Dated this Eighteenth day of February, 1875.

Wm. H. Reynolds,
General Agent for Great Britain and Ireland.

(Note.—This form is to be handed to the Purchaser.)

Street Lighting Lamps.

I should like to know if any of your readers have suitable curves showing how the wattage and candle-power of an average vacuum metal-filament lamp vary over a period of 3,000 hours burning when the voltage has been kept more or less that for which the lamp is made throughout the test.

Engineer.

November 7th, 1923.

BUSINESS NOTES.

Bankruptcy Proceedings.—Percy Boswell (trading as Boswell & Co.), electrical engineer, 110, Ebury Street, S.W.—The public examination of this debtor was held on Wednesday last week at the London Bankruptcy Court, the accounts showing liabilities of £421, against assets valued at £185. Replying to the Official Receiver, debtor said he served in the Army from October, 1915, to April, 1920. On the death of his father in June, 1922, he received a legacy of £1,000 under his grandfather's will, and in the following month he commenced business as above. At first he had a partner, who provided no capital and received £2 a week plus commission, but the partner retired in January, 1923, and witness continued alone until the following July, when he filed his petition. The business was not actually solvent when the partner retired. Witness attributed his failure to depression in trade and bad debts. The examination was concluded.

Alfred James Barlow (trading as Barlow Bros.), electrical and general engineer, 9, Brunswick Place, City Road, E.C.—A sitting of the London Bankruptcy Court was held on Wednesday last week before Mr. Registrar Mellor for the public examination of this debtor, who petitioned the Court last April, with liabilities of £1,834, against assets valued at £1,556. Questioned by Mr. Waterer (Official Receiver), the debtor stated that he was employed in the trade for eight years prior to December, 1911, and then with £250 capital commenced business as above. He continued it until last April, when he closed down for the reason that his largest creditors had obtained a judgment against him. The failure was due to depression in trade, bad debts, and depreciation in the value of the stock-in-trade, machinery and fittings. The books of account disclosed his full financial position. The trading account, dated September 30th, 1922, disclosed a surplus of £2,997 and a net profit of £1,988. Asked how he accounted for the disappearance of that surplus in a short time, the debtor replied that it was due to the fact that certain of the stock became unsaleable owing to some of his customers stopping their orders, and he was unable to realise it. It was only when he found that he could not dispose of that stock that witness realised his insolvency, and since then he had only incurred a very small amount of debts. The examination was concluded.

E. W. J. Whitelock, electrical engineer, 4, Leagrave Road, and 7, Cheapside, Luton.—The first meeting of creditors was held on October 20th at the Official Receiver's office, The Parade, Northampton. The following are creditors:—

	£		£
Ansell & Jones	12	Metropolitan-Vickers Electrical Co., Ltd.	300
Borough Engineering Works ...	12	Parsons Bros.	13
Belling & Co.	30	Priory Electrical Engineering Co.	24
S. Cliff	14	G. Smith & Co., Ltd.	18
Claremont, Johnson & Co. ...	15	Sloan Electrical Co., Ltd. ...	51
A. J. Dero & Co.	28	Siemens Bros. & Co., Ltd. ...	15
Electrical Stores	30	Mrs. C. F. Whitelock	281
Electrical Trade Supplies, Ltd.	66	Mrs. C. F. Whitelock	50
Igranic Electric Co., Ltd. ...	13	Mr. Warwick	210
P. T. King	22	Wholesale Fittings Co.	18
A. Lee & Co.	10	Wales Bros.	12
London Factors & Agents, Ltd.	29		

F. J. Matson, trading as the Magandynamo Co., 24, Rider Road, Woodhouse, Leeds, and lately trading as the Sunnyvale Engineering Co. at Asquith Street, Woodhouse, Leeds, automobile electrical engineer.—The public examination was held on November 6th at the County Court House, Albion Place, Leeds. The statement of affairs disclosed a deficiency of £296. Debtor attributed his position to insufficient capital to commence with. In reply to questions by the Official Re-

ceiver, debtor stated that during the war he invented a field telegraph installation that could not be "tapped," but he did not realise any profit by it. The examination was adjourned to be closed.

Malcolm Thos. Birch Gordon, electrical and general merchant, trading as "Thomas Gordon," late of 20, Western Broadway, King Street, Hammersmith.—This bankrupt failed in February, 1921, and on November 9th he applied to Mr. Registrar Francke at the London Bankruptcy Court for an order of discharge. Mr. F. T. Garton, Official Receiver, reported that in May, 1915, the bankrupt and two other persons, each contributing £25, commenced business as dealers in portable electric lamps, and traded at the above address as the "Telox Co." In the following November their principal suppliers discovered that the bankrupt's partners were two of their employés, and in consequence discharged them and ceased to supply goods to the partnership. Owing to that action the business declined and the partners withdrew. In February, 1916, the before-mentioned suppliers agreed to again supply the bankrupt with goods, and he continued the business under the style of "Thomas Gordon" successfully until April, 1919, when the lighting restrictions were removed. He carried on, however, until December, 1919, when the principal suppliers took back stock to the value of £700, and in the following March he filed a declaration of inability to pay his debts. The failure was attributed to heavy interest on borrowed money, bad debts, law costs, and falling off of trade owing to the Armistice. The offences reported were (1) insufficiency of assets to equal 10s. in the £ on the amount of the liabilities; and (2) omission to keep proper books of account. An order of discharge was granted subject to a judgment for £5 to be satisfied by an immediate payment.

Brenchley Barrett Kingsford, 88, Kingsway, W.C.—An application for an order of discharge was made on November 9th to Mr. Registrar Francke at the London Bankruptcy Court on behalf of this bankrupt, who failed in November, 1922, with liabilities of £14,239. Mr. F. T. Garton, Official Receiver, reported that the assets had so far yielded only 4s. 5d., but a further £400 was expected to be received, and a dividend of 3d. in the £ would probably be paid. The applicant had for the past 23 years acted as director and secretary of an electrical company. He attributed his insolvency to heavy interest on borrowed money, law costs, and liability as surety for cash advanced to other persons, in respect of which he received no consideration. It further appeared that the bankrupt had been in financial difficulties since 1906, when he had an income of £500 per annum, on which he had to keep his wife and himself, his wife's mother, and the latter's nine children. Owing to that fact he had recourse to moneylenders, and the real cause of the failure was accumulated interest charges. After hearing Mr. E. W. Hansell in support of the application, his honour granted a discharge, subject to a judgment for £1,000 to be satisfied by an immediate cash payment.

G. W. Taylor (G. W. Taylor & Co.), electrical engineer, 2, South View, London Road, Fletton.—First meeting, November 16th, at the Official Receiver's office, 5, Petty Cury, Cambridge. Public examination, November 30th, at the Law Courts, Peterborough.

G. Hill, G. Noble, and E. Cowley (G. Hill & Co.), electrical engineers, 22, Chantry Lane, Great Grimsby.—Trustee, Mr. J. Fildes, Official Receiver, St. Mary's Chambers, Great Grimsby, released November 6th.

W. T. Garnett (W. T. Garnett's Cable Co.), electric cable and wire manufacturer, Barker End Mills, Bradford.—Last day for proofs for dividend November 24th. Trustee, Mr. W. Durrance, Official Receiver, 12, Duke Street, Bradford.

S. B. Weston (Westforrest Radio Co), wireless apparatus manufacturer, Utworth Manor, Crauleigh, and Playhouse Arcade, High Street, Guildford. Receiving order made on November 9th, on debtor's own petition.

H. J. W. Embury and K. S. Embury (H. & K. Embury), electrical and mechanical engineers, 29 & 110, Queen Street, Newton Abbot.—Last day for proofs for dividend, November 28th. Trustee, Mr. A. L. Honey, 23, Catherine Street, Exeter.

H. J. W. Embury (separate estate).—Last day for proofs for dividend, November 28th. Trustee, Mr. A. L. Honey, 23, Catherine Street, Exeter.

P. M. Rogers (Longbridge Engineering Co.), electrical engineer, 40, Portland Street, and Great Darkgate Street, Aberystwyth.—First and final dividend of 1s. 10d. in the £ payable November 21st, at 4, Queen Street, Carmarthen.

Company Liquidations.—Morgan & Taylor's Radio Electric, Ltd., 122, Wellington Street, Cardiff.—The creditors interested herein were called together recently at the offices of Messrs. Clark, Dovey & Co., 31, Queen Street, Cardiff. The statement of affairs presented showed liabilities of £3,920, of which £3,044 was due to the trade, while the bank was scheduled for £775, and Mr. G. P. Taylor—one of the directors—was set down for £101. The assets were estimated to realise £2,071, from which had to be deducted £89 for preferential claims, leaving net assets of £1,982, or a deficiency of £1,938. The assets consisted of: Stock at cost, £1,011, estimated to realise £682; goods out on sale or return, £116; goods out on approval or sample, £104; cash in hand, £10; machinery and plant, £49; dynamos, tools, &c., £52; office furniture, £50; good book-debts, £958; doubtful and bad debts, £546, expected to produce £40; and investment in British Broadcasting Co., £10. The company held ten shares of £1 each in the British Broadcasting Co. The issued capital of the company was £703, and as regarded the shareholders there was a deficiency of £2,641.

Mr. Clutterbuck said that at a conference of the creditors already held an offer was submitted of 5s. in the £, payable in cash, but the creditors agreed to accept not less than 10s. in the £. He added that the present statement of affairs differed materially from the one previously submitted. The earlier statement of affairs showed the position as at July 31st last, while the present one was dated October 15th. The bank overdraft had been reduced by about £200, while the stock was only estimated to realise £682, as against £1,542 in the earlier statement. Some of the stock was obsolete and it had been substantially written down in consequence. The machinery and plant had also been reduced. It was possible, however, that the book debts might realise more than the amount shown in the statement of affairs, as some which were originally said to be doubtful were now thought to be good. In the July statement the liabilities were shown at £4,046, against assets of £2,750, or a deficiency of £1,296, whilst the later statement of affairs showed a deficiency of £1,938 on liabilities of £3,919. The liquidator added that he had approached the gentleman on whose behalf an offer of 5s. in the £ was originally put forward to see whether 7s. 6d. in the £ could be accepted, but the answer was in the negative.

After discussing the position a resolution was passed confirming the voluntary liquidation of the company, with Mr. Clutterbuck as liquidator, while a committee was also appointed consisting of the representatives of the India-Rubber and Gutta-Percha Telegraph Works Co., Ltd., Western Electric Co., Ltd., Auckland & Sons, McMichael, Ltd., Siemens Bros. & Co., Ltd., and Edison Swan Electric Co., Ltd.

Cardiff Electric and Wireless Supply Co., Ltd.—Winding-up voluntarily. Liquidator, Mr. T. H. Coath, Andrew's Buildings, Queen Street, Cardiff. Meeting of creditors at the Liquidator's offices, November 24th. Particulars of claims by November 14th.

Hong-Kong Tramway Co., Ltd.—Winding-up voluntarily. Liquidator, Mr. E. R. Morris, 3, Lombard Street, E.C. Meeting of creditors, November 16th.

Radyr Electric Co., Ltd. — Winding-up voluntarily. Liquidator, Mr. H. W. C. Evans, 4, Park Place, Cardiff. A meeting of creditors was called for November 16th at the Liquidator's offices.

Electric Blasting Apparatus Co., Ltd.—A meeting of members is called for December 14th at Nobel House, Buckingham Gate, S.W., to hear an account of the winding-up from the Liquidator, Mr. P. J. Cory.

Wireless Installations, Ltd.—First meetings of creditors and contributories, November 22nd, at Carey Street.

Dissolutions of Partnership.—Johnson & Co., electrical contractors, 57, Surrey Street, Sheffield.—Mr. E. Johnson and Mr. J. W. Rippon have dissolved partnership. Debts will be attended to by Mr. J. Hancock, chartered accountant, 57, Surrey Street, Sheffield.

T. & H. Joyce, dealers in electrical supplies, 210b, Shaftesbury Avenue, W.C.1.—Mr. G. G. Crutchley, Mr. T. H. Joyce, and W. E. Williams have dissolved partnership. Messrs. Joyce and Williams will attend to debts.

Victoria Electrical Co., electrical engineers, 30, Great George Street, Leeds.—Mr. J. C. Ridsdale and Mr. E. S. Jodrell have dissolved partnership. Mr. Jodrell is attending to debts and continuing the business.

Dees & Matson, electrical engineers and suppliers, 33, Great Market, and 5, Wilsons Court, Newcastle-upon-Tyne.—Mr. A. E. Dees and Mr. G. Matson have dissolved partnership. Mr. Dees will attend to debts.

Trade Announcements.—Mr. P. Fitzgerald, electrical engineer and contractor, of 1, Brighton Terrace, Cobh (Queenstown), has opened an office and showroom at 16, East Beach, Cobh (Queenstown), and wishes to receive trade catalogues and price lists of electric lighting sets and accessories.

Mr. H. E. Massingham has commenced business in electrical, mechanical, and wireless supplies at 109, Edith Road, West Kensington, W.14, and wishes to receive trade catalogues.

Messrs. Major & Co., Ltd., manufacturers of insulating varnishes, &c., Sculcoates, Hull, have decided to centralise the offices of the company, as from November 10th, at 12, Norfolk Street, Strand, W.C.

The North Electrical Co. has commenced business as electrical engineers and contractors at 63b, North Street, Leeds, and wishes to receive offers of agencies.

The Coronium Metal Co., Ltd., Brentford, has appointed the Equipment and Engineering Co., Ltd., Strand, W.C.2, sole selling agent for all its products. Mr. G. F. Craven has left the board of the Coronium Co. to join the staff of the other company.

Messrs. Selbourne, Ltd., have removed from King Street, E.C.2, to Bank Chambers, 329, High Holborn, W.C.1.

Catalogues and Lists.—Gent & Co., Faraday Works, Leicester.—Illustrated and priced leaflet, No. 91, dealing with low-frequency transformers in three patterns.

The Foster Engineering Co., Ltd., Morden Works, Wimbledon, S.W.19.—Three illustrated leaflets dealing respectively with "Apex" switchgear (announcement of price reduction); gasfilled lamps; and lanterns for gasfilled lamps.

Sterling Telephone and Electric Co., Ltd.—Illustrated and priced booklet, No. 364, describing radio receiving sets and accessories; also the following priced and illustrated leaflets: No. 367, describing the "Sterling" metal-screened radio unit system; No. 380, dealing with the "Baby" loud-speaker and amplifier units; No. 381, concerning the crystal and valve receiver with loud-speaker combination for local use; No. 383, describing the DE3 low-temperature valve; No. 384, describing the LS5 power valve; and a leaflet describing the "Three flex" frame-aerial set.

The Edison Swan Electric Co., Ltd., 123-125, Queen Victoria Street, E.C.4.—A number of booklets, &c., dealing with electric fans; house service cut-outs, joint boxes, &c.; electrical accessories; the "Ediswan" house-wiring system; d.c. motors; vacuum and gasfilled lamps of all types; thermionic valves; silk lamp shades; and radio apparatus.

The Cambridge & Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W.1.—A comprehensive catalogue of "Cambridge" temperature measuring, controlling, and recording instruments, including thermometers and pyrometers of various patterns. Fully illustrated.

The Rustnot Co., 73, Bridge Street, Manchester.—A leaflet advertising "Rustnot," a transparent rust preventive and protector for metals.

The General Engineering Co. (Radcliffe), Ltd., 73, Bridge Street, Manchester.—A letter advertising vacuum drying and pressure impregnating plant for ropes and cables.

The Brazit Material Co., 73, Bridge Street, Manchester.—A pamphlet describing "Brazit" material for repairing breaks in cast iron.

Messrs. Veritys, Ltd., Aston, Birmingham.—Publication No. 949, describing in some detail starting and controlling equipment for all types of a.c. motors. Also a leaflet advertising "Maxlume" reflectors. Both publications are fully priced.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Three illustrated booklets dealing respectively with "Simplex" lighting fixtures and accessories; industrial lanterns, steel reflectors, &c.; and "triple-purpose" electric signs. Also a folder containing illustrations of lighting fittings of various patterns and signs.

Messrs. R. K. Webster & Co., Purley Downs Road, Purley, Surrey.—An illustrated list giving details and prices of d.c. motors and generators (including fractional h.p. motors), and spare parts.

The Bedford Engineering Co., Bedford.—A well illustrated publication containing particulars of locomotive steam and electric cranes, overhead electric cranes, grabs, and other hoisting machinery.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—November price list of electrical supplies of all kinds, including materials and appliances.

Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, W.C.1.—An illustrated catalogue of radio apparatus, describing complete sets and components. Priced.

The Falkirk Iron Co., Ltd., Falkirk, N.B.—Leaflet No. 356, giving particulars and prices of "Falco" electric cookers, and Leaflet No. 361, dealing with the "Falco" electric cooker combined with the "Companion" water boiler.

The Mullard Radio Valve Co., Ltd., 35a, Claybrook Road, Hammersmith, W.6.—A showcard illustrating the "Wecovalve" dull emitter valve and accessories—dry cell, adaptor, and socket.

Messrs. Landis & Gyr, Ltd., Elgee Works, Windmill Road, Hampton Hill.—An illustrated pamphlet giving a detailed description of the construction of current transformers for dealing with loads up to 500 A.

The Telephone Manufacturing Co., Ltd., Hollingsworth Works, Martell Road, West Dulwich, S.E.21.—Two coloured showcards advertising "Soutterware" art metal and electrical fittings, and "True-Music" loud speakers respectively.

Our Foreign Trade.—October Figures.—The following were the values of imports and exports of electrical goods and machinery during October, 1923:—

	Oct. 1923.	Inc. or dec.	Inc. or dec. 10 months 1923.
Imports.—	£	£	£
Electrical goods and apparatus	256,413	+ 83,859	+ 725,504
Machinery	775,394	+ 92,077	+1,025,370
Electrical machinery ...	75,009	+ 30,471	− 173,020
Exports.—			
Electrical goods and apparatus	833,025	+130,800	+ 787,926
Machinery	3,736,635	−824,846	−5,006,248
Electrical machinery ...	344,534	+ 38,478	− 406,015
Re-exports.—			
Electrical goods and apparatus	10,248	+ 3,111	− 53,571
Machinery	113,707	− 18,570	− 18,195
Electrical machinery ...	7,021	+ 3,066	+ 47,135

Sequestration.—R. V. McNaughtan, electrical engineer, 5, Gordon Street, Paisley.—The estates of this debtor were sequestrated on November 8th, by the Sheriff of Renfrew and Bute. Meeting to elect Trustee and Commissioners, November 19th, at the George Temperance Hotel, Three Gauze Street, Paisley. Mr. H. Crawford, agent, 19, High Street, Paisley.

Book Notices.—Circular No. 122 of the U.S. Bureau of Standards, "Sources of Elementary Radio Information" (16 pp.). Washington: Government Printing Office. Price 5 cents.—In the main, this is a guide to the literature of radio-telegraphy and telephony, containing lists of periodicals, U.S. Government publications, and books upon the subject, both English and American. For the rest the publication consists of notes on regulations, codes, amateur stations, &c.

"Where to Buy Everything Electrical." October, 1923, edition (136 pp.). London: S. Davis & Co. Price 2s. 6d., post free.—This half-yearly guide for purchasers of electrical goods, in which the names of all electrical manufacturers and agents appear under classified headings, is probably the best publication of its kind, valuable to both buyers and to the firms themselves.

"The *Transactions* of the South African Institute of Electrical Engineers." Vol. XIV, Part 9. September, 1922. Johannesburg: The Institute. Price 2s.—The principal paper in this number is that on "Pulverised Coal as a Fuel in Practice," by Mr. A. E. Val Davies, M.I.E.E.

"L'Electrification général du Territoire," by C. Boileau. Pp. 160, illustrated. Paris: J. Tequi. Price 10 fr.

"Alternating Currents," by A. E. Clayton. Pp. vii+296; 253 figs. London: Longmans, Green & Co. Price 10s. 6d. net.

"Atoms and Electrons," by J. W. N. Sullivan. Pp. 188. London: Hodder & Stoughton, Ltd. Price 2s. 6d. net.

"Wireless of To-day," by C. R. Gibson and W. B. Cole. Pp. 318. Illustrated. London: Seeley, Service & Co. Price 7s. 6d. net.

British Empire Exhibition Notes.—On November 12th, Sir Robert McAlpine, on behalf of his firm, handed over to the board of the Exhibition the completed Palaces of Industry and Engineering, which together cover an area of about 25 acres. A vast amount of material, all produced within the Empire, has been employed in the construction of these buildings, the framework alone accounting for 2,500 tons of steel. The ducts for electric cables in and around the building have an aggregate length of three miles.

Transvaal Power Supply.—The inquiry by the South African Electricity Commissioners into the application of the Victoria Falls and Transvaal Power Co. for sanction to the erection of a large generating station at Witbank was recently resumed after some delay caused by action taken in the Courts by the mining interests, which protested that vital information was being withheld by the Power Co. Mr. C. H. Merz, according to a *Times* report, in his evidence said that the application was of great importance to the railway administration in view of the general electrification scheme which it had adopted. As a result of the special conditions as to coal—there being a practically unlimited supply of very cheap coal in the Witbank field—the cost of generating would be comparable with the cost at any hydro-electric plant in the world. Another factor was the extraction of by-products. Mr. Merz contested the general idea that competition obtained more favourable terms for the consumer. Experience in other parts of the world showed that such was not the case, as it meant the use of more capital and the consumer had to pay. He considered the best interests of the district would be served by a "regulated monopoly"—a supply the rates for which were regulated by an impartial body, such as the Electricity Board. He also emphasised the urgency of the present application. He anticipated that in two or three years' time the generating station at Witbank would be handed over to the Commission. The question of rates charged for the power would be a matter for revision by the Electricity Control Board from time to time. The inquiry adjourned for a week to permit of further conferences with the mining companies.

Catalogues Wanted.—Messrs. Smith & Jordan, electrical engineers and contractors, The Arcade, Redcar, Yorks., wish to receive catalogues of electrical and wireless goods.

Catalogues for Turkey.—The Commercial Secretary at Constantinople reports that he has arranged a representative selection of catalogues of British firms in his office at the British Consular residence at Galata, Constantinople. In order, however, that British catalogues may be available for traders in the interior, arrangements have been made, by courtesy of the Imperial Ottoman Bank, for British catalogues to be displayed at its agencies in the following towns in the interior:—Broussa, Adrianople, Konia, Smyrna, Trebizond, Eskishehir, Adana, Angora, Mersina, and Samsoon. British firms desiring their catalogues to be displayed at any or all of these towns are invited to send sufficient copies to the Imperial Ottoman Bank, Ltd., Trade Development Department, 26, Throgmorton Street, London, E.C.2, which will arrange for their re-transmission to Turkey, subsequently submitting a claim for the cost of postage.

Import Duties Advisory Committee.—It is officially announced that the Prime Minister has appointed the following committee to advise his Majesty's Government in connection with the preparation of the proposed duties on manufactured goods:—

Lord Milner (Chairman), Lord Kylsant, Sir Algernon Firth, Sir Peter Rylands, Sir William Ashley, Professor W. A. S. Hewins, and Mr. A. Pugh, General Secretary of the Iron and Steel Trades Confederation.

Mr. A. Pugh, General Secretary of the Iron and Steel Trades Confederation.

For Sale.—Gillingham (Kent) Corporation electricity department invites offers for three 75-h.p. motor-generator sets, one h.p. and one l.p. switchboards, &c. Ilkley Urban District Council has for disposal two 100-kW condensing engines and Phœnix dynamos, with switch panel, and one motor-generator battery charging set. Mountain Ash Urban District Council invites offers for four 33¼-kW single-phase transformers. By direction of Geo. Cohen & Armstrong Disposal Committee Mr. A. Davis will sell by auction, on Thursday, November 29th, the remaining plant, machinery, &c., at the Hackney Marshes Depôt. (See our advertisement pages to-day.)

Electric Railway Workers' Wages.—The Industrial Court has published two awards in connection with wages of men employed by the London Electric Railways. In the first case the Electrical Trades Union contended, broadly, that the rates current in the contracting industry should be paid to electricians employed on new work by the London Electric Railways, and designated "temporary" employés, as the work in question was not work which men in the regular service of the companies were normally called upon to perform. The Court decided (Award No. 846) that such men should be paid the rates agreed between the National Federated Electrical Association and the E.T.U., less 1½d. per hour. Payment to the companies' regular staff or to men who are afterwards to be absorbed into the establishment is prescribed by Award No. 728.

The other decision relates to an application by the National Union of Railwaymen for an increase in the rate being paid to pipe fitters in the employ of the London Electric Railways to bring them on the same footing as Grade I fitters. The Court considers that as the experience and training of these men is confined to a particular branch, whereas Grade I fitters are skilled in many branches, the claim of the Union is not established.

Workmen's Compensation.—The following resolutions recommended for adoption by the Imperial Economic Workmen's Compensation Committee were agreed to by the Conference:—

That the Conference, taking note of the existing restrictions in the workmen's compensation laws of certain parts of the British Empire on the payment of benefits to workmen and their dependents on the ground of non-residence in the State in which the accident happened, and having regard to the tendency of such restrictions to discourage movement within the Empire, is of opinion that no British subject who is permanently incapacitated, and no dependent of a British subject who has been killed, by accident due to his employment in any part of the Empire, should be excluded from any benefit to which he would otherwise be entitled under the Workmen's Compensation law of that part of the Empire on the ground of his removal to or residence in another part of the Empire.

That the Conference, having had its attention drawn to cases where British sailors injured by accident while serving on ships registered in some part of the Empire have had no claim to compensation owing to the law of that part of the Empire being restricted, in its application to seamen, to accidents occurring within territorial waters or other limited area, is of opinion that the Government of any such part of the Empire should ensure that the benefits of its compensation law will extend to all accidents to seamen serving on ships registered within such part of the Empire wherever the ship may be when the accident takes place. And, furthermore, the Conference invites the Government of any British Colony or Protectorate, where there is a register of shipping, but where legislation giving compensation rights to seamen does not at present exist, to consider the adoption of such legislation.

That the Conference, taking note of the disabilities imposed under the workmen's compensation laws of certain foreign countries on British subjects residing in those countries and their dependents, invites each Government of the Empire, regard being had to its own particular conditions, to consider the possibility of adopting in workmen's compensation legislation the principle of reciprocity, that is, that the benefits of such legislation should be accorded to subjects of foreign countries upon the condition that, and to the extent to which, such foreign countries accord reciprocal treatment to British subjects.

The Boilermakers' Lock-out.—Negotiations between the Shipbuilding Employers' Federation and the Boilermakers' Society lasted for twelve hours on Saturday last, but no definite result was announced. It was decided to hold a further conference at Edinburgh on Wednesday last. *The Times* understands that a proposal was submitted by the boilermakers by which the Union agreed to work the agreement for a limited number of months. The agreement was made for a period of three years from March last subject to termination upon either party's giving six months' notice. The proposal of the Society would therefore have given it power to reopen the question in the spring of next year, and on this account it was unacceptable to the employers. Attention was also devoted to the alleged anomalies caused by the agreement, and the boilermakers were asked to bring specific instances before the Edinburgh conference for investigation and rectification if possible.

Lead Report.—Messrs. James Forster & Co. report, under date November 10th: After a steady market for the first four days with a firm undertone, there was a sudden spurt yesterday of 15s. a ton for November and December lead, 10s. a ton for January, and 5s. a ton for February, a backwardation of 60s. a ton being established. The close is firm at £30 15s. for November, £29 7s. 6d. for December, and £28 7s. 6d. for January, and £27 15s. for February. Imports for October were far below the average of the previous months of this year, and as they promise to be on a small scale again this month, it is certain that with consumption, particularly in the electrical trades, largely increased and increasing, there will be difficulty in meeting even normal requirements.

Imperial Economic Conference.—The Economic Conference last week gave consideration to the proposal of Mr. Bruce, the Australian Prime Minister, for setting up a permanent Imperial Economic Committee, comprising members of the Governments represented at the Imperial Conference, to consider and advise upon any matters of economic or commercial character referred to it by any of the respective Governments, apart from matters coming within the scope of the Imperial Shipping Committee. The scheme was not favoured by Canada, on the ground that a permanent committee would detract from the freshness and originality of the Imperial Economic Conference. However, the following resolution was passed:—

That in the opinion of the Imperial Economic Conference, Canada dissenting:

(1) It is desirable to establish an Imperial Economic Committee, comprising representatives of the Governments represented in the Imperial Conference and responsible to those Governments.

(2) The formation of the Committee should be to consider and advise upon any matters of an economic or commercial character, not being matters appropriate to be dealt with by the Imperial Shipping Committee, which are referred to it by any of the constituent Governments; provided that no question which has any reference to another part of the Empire may be referred to the Committee without the consent of that other part of the Empire. It was agreed that in the constitution of the Committee representation should be allotted to the various constituent Governments as follows:—

	Members.
Great Britain	4
Dominions (each)	2
India	3
Colonies and Protectorates	2

British Trade-Mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one month from the dates mentioned below. In the case of foreign applications the names and addresses of the British representatives are also given:—

Casi. No. 439,919. Class 5.—Electro-metallurgical products. Filip Tharaldsen, 18, Josefingate, Christiania, Norway. (Dicker & Pollak, 20 and 23, Holborn, London, E.C.) November 7th, 1923.

Crocker Wheeler Co., Ampere, N.J. (lettering and design). No. 431,048. Class 6.—Electric motors, generators, transformers, &c. Crocker Wheeler Co., Ampere, N.J., U.S.A. (White, Langner, Stevens & Parry, Jessel Chambers, 88-90, Chancery Lane, London, W.C.) November 7th, 1923.

Music Master. Geraco (lettering and design). No. 438,452. Class 8.—Receiving sets, sound reproducers, sound amplifiers, &c., all for use in wireless telephony. Wireless Radio Corporation, Tenth Street, Philadelphia, U.S.A. (F. W. Golby, 3, John Street, Bedford Row, London, W.C.) November 7th, 1923.

Air-Way. No. 436,950. Class 8.—Bellringers, electric transformers and parts thereof, and apparatus for use in wireless telegraphy and telephony. The Air-way Electric Appliance Corporation, 618-622, Broadway, Toledo, O., U.S.A. (Marks and Clerk, 57-58, Lincoln's Inn Fields, London, W.C.) November 7th, 1923.

Ever-Ready. No. 424,344. Class 8.—Dry batteries and cells (electrical) and accumulators. No. 424,346. Class 13.—Electric lamps, lamp cases, switches, &c. No. 424,347. Class 14.—Electric lamp cases, &c. The Ever-Ready Co. (Great Britain), Ltd., Hercules Place, Holloway, London N. November 7th, 1923.

Priorphone. No. 436,953. Class 8.—Electric wireless apparatus. Walter H. Collins, trading as W. H. Collins and Co., Excelda Works, Rookery Road, Handsworth, Birmingham. November 7th, 1923.

Pyramid, Wates Bros. (lettering and design). No. 437,256. Class 8.—Electric accumulators and batteries. Frank S. Spodner Wates, trading as Wates Bros., 13-14, Great Queen Street, London, W.C. November 7th, 1923.

Sixelcryst. No. 440,743. Class 8.—Natural and synthetic crystals and instruments or apparatus in connection therewith used for the detection of wireless signals. John H. Long, 17, Leather Lane, London, E.C. November 7th, 1923.

Nirvana (lettering and design). No. 428,245. Class 13.—Sparking plugs, electric fittings, &c. Lewis Banks & Co., Ltd., 45-49, Holborn Viaduct, London, E.C. November 7th, 1923.

Ventex. No. 438,258. Class 13.—Fusible electrical cutouts. Holmes & James, Ltd., Excelsior Works, Ellis Street, Birmingham. November 7th, 1923.

Insulatum. No. 439,028. Class 50.—Mineral and other oils prepared for electrical insulating purposes. The Vacuum Oil Co., Ltd., Caxton House, Westminster, S.W. November 7th, 1923.

Local Exhibitions.—WALSALL.—The Corporation Electricity Department recently arranged an attractive exhibition jointly with the Gas Department in connection with a shopping festival week.

ALDERSHOT.—The Electricity Supply Department (engineer: Mr. F. Garside) has opened an inquiry office and demonstration room at 101, Victoria Road, for the period of the Shopping Week. The articles exhibited and demonstrated are modern types of vacuum cleaners, electric fires, irons, toasters, fans, and examples of small cooking devices, modern methods of window lighting by "X-ray" reflectors, and modern fittings for efficient factory lighting.

LIGHTING AND POWER NOTES.

Ashton-under-Lyne.—Extension of Supply.—The Corporation intends to make application in a new Parliamentary Bill for powers to give a supply of electricity to the areas of Hurst and Limehurst. The Limehurst Council has decided to support the Bill, provided that the charges for electricity are no more than in Ashton.

Bedford.—Year's Working.—The accounts of the municipal electricity undertaking (borough electrical engineer: Mr. R. W. Phillips) for the year ended March 31st last show a total revenue of £60,440, as against £72,709 in the preceding year. Working expenses totalled £35,727, as compared with £48,237, leaving a gross profit of £24,713 (£24,474). The net result, after the payment of interest, &c., was a profit of £2,101, which was contributed to relief of the rates. The previous year's working showed a profit of £1,736. A total of 4,664,225 kWh of energy was sold, and the maximum demand was 2,840 kW.

Clacton.—New Plant.—The Urban District Council is to install a new 750-b.h.p. Diesel engine, with equipment, at the electricity works, and application is to be made to the Unemployment Grants Committee for a grant towards the cost of the plant. The Electricity Committee has also recommended that application be made to the Electricity Commissioners for sanction to the borrowing of £10,000 to carry out the scheme.

Continental.—Esthonia.—*State Peat Station.*—The construction of a large electric power station has now been completed at Ellamaa, and within the course of a week or so will supply electricity to the State railways between Reval-Hapsal-Baltiski, the radio station at Hapsal, the towns of Reval and Hapsal, and various other places, including many industrial concerns. The station is situated about 60 km. from Tallinn (Reval) on the Ellamaa peat bogs near the Tallinn-Hapsal railway line. Its establishment and the necessary machinery for excavating the peat, such as peat dredges, presses, &c., has cost about 32,000,000 Esthonian marks. Accommodation for 1,000 men is provided at the works. The whole of the electricity has already been contracted for by municipal and co-operative bodies and industrial concerns, which have undertaken to construct the necessary distribution lines, but have the right to dispose of the energy at a fixed sum, so that speculation is eliminated.

The station is equipped with modern machinery, comprising one Korting 310-h.p. peat gas engine, coupled to a 250-kVA electric generator and three Lanz steam engines of 680 h.p. each, coupled to three 500-kVA electric generators. The generators produce three-phase current at 3,000 volts, of which about one-third is consumed by the State peat mines on the adjoining Ellumaa peat bogs, the rest being transformed partly up to 15,000 volts, which is sent through a high-pressure line of 47 kilometres to Hapsal, and partly to 35,000 volts, which is sent to Tallinn. The peat used as fuel for the production of energy is obtained from the adjoining Ellamaa and Soonisto deposits, the area of which is 1,500 acres, the thickness of the peat layers being from 4 to 6 metres. The deposits are estimated to provide fuel for more than 175 years at the present rate of consumption.—*Reuter's Trade Service.*

Poland.—The new company recently formed in Brussels with the title La Société d'Entreprises Electriques en Pologne has acquired from the Société des Tramways et Electricité en Russie the electricity supply undertakings in the towns of Czenstochowa, Radom, and Bailystok. It has also secured a large interest in the Société Polonaise des Reseaux Electriques which, in conjunction with the Société Polonaise Force et Lumière, is preparing plans for a high-pressure electricity distribution system to supply the towns of Lodz, Warsaw, Sosnowice, Czenstochowa, Radom, and Kielce.

Spain.—The amount of electrical machinery installed in Spain was increased in 1922 by 60,000 h.p. The total capacity of the hydro-electric works at present in operation is estimated at 654,000 h.p.

Bavaria.—According to *The Times Trade and Engineering Supplement*, considerable progress has been made in the development of the water-power resources of Bavaria. The project includes the laying of 1,154 miles of 110,000-V transmission lines, and the erection of 43 power stations and 11 transformer stations, with an estimated total capacity of 700,000 h.p.

Darlington.—Loan Sanctioned.—The Town Council has received the sanction of the Electricity Commissioners to a loan of £2,000 for laying two new feeder cables.

Dumfries.—Electricity Extensions.—The Town Council has decided to extend the electricity works at an estimated cost of £22,000.

Dutch East Indies.—Suggested Standardisation.—According to *Commerce Reports*, a conference of engineers has submitted the following proposals for the standardisation of electricity supply to the authorities, with the suggestion that the standards shall be followed after January 1st, 1924:—Preference shall be given to alternating current wherever possible. The current shall be 50 periods per second, as is now usual in the Netherlands East Indies. Normal service shall be: 220/127 V for general use; 380 V for high-power installations; 6,000 V for the production and transmission of current; 15,000 V for transmission purposes only. In cases where direct current is used pressures of 110 and 220 V are considered the most appropriate, but in some cases as high as 440 or even 600 V may be used. In cases where direct current is employed for electric traction no change in existing installations is to be undertaken in the near future. The conference recommends that all companies be compelled by the Government to conform to the foregoing plans of standardisation.

Harpenden.—Electricity Charges.—The North Metropolitan Electric Power Supply Co. has applied for an Order to charge a flat rate of 8d. per kWh, or for the equivalent of the first 100 hours' use per quarter of the maximum demand, 10d. per kWh, and 4d. beyond, with minimum payments of 10s. for the winter quarters and 6s. 8d. for the summer quarters.

Hazel Grove and Bramhall.—Electricity in Bulk.—The Urban District Council has approved the agreement prepared by the Electricity Sub-Committee, between the Council and the Stockport Corporation, for a supply of electricity in bulk from the latter authority.

Ilkley.—Electricity Agreement.—Negotiations between the Urban District Council and the Yorkshire Electric Power Co. have been concluded, and an agreement signed, for the supply of electricity in bulk by the company for distribution by the Council. The Council has for the past eight or nine years possessed its own generating station, but it has been found to be inadequate to meet the growing winter demand. Application is to be made to the Electricity Commissioners for sanction to borrow £6,800 for the necessary alterations to the station. It is proposed to install a 250-kW rotary-converter so that the service can be maintained without difficulty this winter.

Irish Free State.—Thurles.—The Urban District Council has adopted a report of the Electricity Committee, recommending adherence to the d.c. system. The Ministry of Industry and Commerce had suggested that the system should be changed to a.c. to permit, in future, of the linking-up with other towns in the event of a national electrification scheme, at present under consideration by the Government, materialising.

Clonmel.—The Corporation is to obtain expert advice with a view to a scheme for public electric lighting, and application is being made to the Ministry of Industry and Commerce for sanction to a loan for the scheme.

Isle of Man.—Ramsey.—The Gas Co. has applied to the Manx Tynwald Court for permission to introduce a Bill authorising the company to supply electricity. The application has been referred to a committee for consideration.

Liverpool.—Electricity Extensions.—The Liverpool Corporation has laid a 6,000-V high-pressure cable from its generating station at Gateacre to a sub-station which has just been completed at Hunts Cross, whence a supply of electricity is now available for general use.

Morocco.—Hydro-Electric Development.—The efforts of a trust to acquire a concession granting it the monopoly of all the water resources in the French Protectorate have raised the liveliest opposition. The trust comprises the Société Marocain de Distrbution d'Eau, de Gaz et d'Electricité, the Compagnie générale de Chemins de Fer de Morocco, and some big Parisian electricity undertakings. The trust's aims are to monopolise all the constructive works needed for electric generation and for the working of railways. The Conseil Superior de Commerce and the Chamber of Commerce of Casablanca have both entered protests, declaring that such a monopoly in the hands of a single firm will compromise the future of the country and should not be accorded without consultation with the advisory chambers.

Northern Ireland.—Portadown.—The Town Council has decided to oppose the Bill to be presented before the Ulster Parliament in connection with the Bann power scheme, on the ground that serious damage would occur to the town on account of flooding, &c. Efforts are to be made to convene a conference of authorities in Co. Armagh, whose interests may be prejudicially affected by the proposed scheme.

North Wales.—Electricity Scheme.—It is anticipated that operations will commence at an early date in the construction of a huge dam at Trawsfynydd, Merionethshire, by the North Wales Power Co., which has purchased about a dozen farms for the purpose. The pond, when completed, will be five miles long by four miles wide. A large generating station will be erected at Maentwrog, from which electricity will be distributed throughout North Wales. The scheme, it is hoped, will facilitate the development of slate quarrying and mines in Merionethshire.

Padiham.—Proposed New Power Station.—Plans have been deposited by the Lancashire Electric Power Co. for a power station which it proposes to erect on a site on Vicarage Farm, Padiham, for the supply of electricity to Padiham and adjacent localities. Burnley Corporation is also seeking powers to carry out a scheme to supply Padiham district with electricity.

Redcar.—Proposed Electricity Supply.—The Town Council has taken a canvass in order to ascertain the probable number of consumers of electricity, and the result, having proved satisfactory, is to be forwarded to the Electricity Commissioners, to whom the Council has applied for an Order.

Ross-Shire.—Electricity Supply.—The County Council has decided to oppose the application of the Strathpeffer and Dingwall Electric Co., Ltd., for an Order authorising it to supply electricity in certain parts of the county.

Sheringham.—Electricity Supply.—At a public meeting on November 9th it was stated that an agreement had been entered into with Edmundson's Electricity Corporation for a supply of electricity to the district, and that the company was applying for an Order authorising it to carry out the scheme. The company offered to give a supply from its station at Cromer a year ago, provided the Council contributed £12,000 of the £15,000 the scheme was then estimated to cost. It is now prepared to give a supply and bear the whole of the cost of the scheme.

Slaithwaite.—Electricity Supply.—The Urban District Council has resolved to exercise its powers, under an Order of 1914, to provide electricity for the district, and has declined proposals for supply by the Electrical Distribution of Yorkshire, Ltd. The whole Council has been constituted an electricity committee, and Mr. J. E. Schofield appointed engineer to carry out the scheme.

Sleaford.—Loan Sanctioned.—The Urban District Council has received the sanction of the Electricity Commissioners to a loan of £2,000 for mains.

Soyland (Yorkshire).—Electricity Supply.—At a recent meeting of the Urban District Council notification was received from the Yorkshire Electric Power Co. of its intention to proceed with the extension of mains to Ripponden, thereby furnishing electricity to Soyland, and that it desired to discuss with the Council the matter of street and other lighting. It was pointed out that at present the supply would be for power only, but lighting would be brought into operation as soon as the Electricity Commissioners had given sanction. A deputation was appointed to negotiate with the Power Co.

Special Orders.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising the Urban District Council of Kettering to supply electricity within the Urban Districts of Market Harborough, Desborough, Rothwell, and Burton Latimer, and parts of the Rural Districts of Kettering, Oxendon, Wellington, and Market Harborough; the Wellingborough Electric Supply Co. to supply electricity within the Urban District of Finedon, part of the Urban District of Irthlingborough, and certain parishes in the Rural District of Wellingborough; the Electrical Distribution of Yorkshire, Ltd., to supply electricity in the Urban District of Burley-in-Wharfedale and certain parishes in the Rural District of Burley-in-Wharfedale; and the Cannock Chase Colliery Co., Ltd., to supply electricity within the Urban District of Brownhills and certain parishes in the Rural District of Lichfield.

Stokesley.—Electricity Supply.—The Rural District Council has agreed to offer no objection to the Middlesbrough Corporation's undertaking the supply of electricity to Nunthorpe. The Corporation is taking over the statutory powers of the Cleveland and South Durham Electric Power Co. to supply the Stokesley area.

Thames Valley.—Mains Extension.—The Metropolitan Electricity Supply Co. is extending its mains through Isleworth and Sunbury to Staines, and through Egham to Slough.

Walton-le-Dale.—Proposed Electricity Scheme.—The Urban District Council proposes to apply to the Electricity Commissioners for an Order authorising it to supply electricity in the district, and, if an Order is obtained, to transfer it to Preston. The Preston Corporation is to be approached on the subject before application is made.

Wanstead.—Electricity Order.—The Urban District Council has consented to the application of the County of London Electric Supply Co. for an Order to supply electricity in the Council's area.

Woodford.—Electricity Agreement.—The Urban District Council has approved a draft agreement with the County of London Electric Supply Co., Ltd., for a supply of electricity. The flat rate for lighting will be 6d. per kWh, and for heating and cooking, 3d. per kWh.

TRAMWAY AND RAILWAY NOTES.

Ashton-under-Lyne.—Railless Cars.—It is proposed to introduce a railless car service between Ashton and Oldham, which can be put into operation at less than half the cost of relaying a double tramway track from Ashton to Hathershaw.

Australia.—Melbourne.—According to the Melbourne *Herald*, the Tramways Board expects to spend nearly £2,000,000 in extending the tramway service by the end of 1925. New lines will absorb £800,000, and of this amount £480,000 will be utilised on works North and North-West of the Yarra. The Board has acquired 16 acres of land at Preston, on which to erect what will probably be the largest workshops in Victoria.

Bournemouth.—Loans Sanctioned.—The Town Council has received the sanction of the Ministry of Transport to the borrowing of £65,000 (subject to reduction by £13,000, to be met out of unappropriated balance) for track renewals, and £70,000 for new cars, and construction of new routes.

Chile.—Railway Electrification.—Electrification of the Ferrocarril del Llano de Maipo, which extends from Santiago to Puente Alto, has recently been commenced by a firm of Chilean contractors. This line connects Santiago with important agricultural and industrial sections. It is expected that the work will be completed in about 13 months. After the existing line is electrified the present rolling stock will be discarded and new equipment, consisting of a freight locomotive and two electric passenger cars, operated. Power at 600 V, direct current, is to be supplied by the Compania Chilena de Electricidad, which will erect a sub-station at Bella Vista. —*Commerce Reports.*

Continental.—Norway.—The Norwegian Storting has adopted a recommendation of the Railway Committee, sanctioning a vote of 3,500,000 kronen for the electrification of the Drammen-Kongsberg railway.

Darlington.—Tramway Improvements.—Mr. J. R. P. Lunn, manager of the Electricity and Light Railways Department, has submitted a report on the advisability of certain tramway improvements. He says that before these can be considered it will be necessary to decide whether to relay the existing tramway track when the rails are worn out. A considerable proportion of the existing track will have to be relaid or abandoned within about five years. The estimated cost of renewing the track would be from about £80,000 to £120,000. Even if a life of 25 years were allowed for the renewed track, the capital charge would amount to between £6,000 and £9,000 per annum, as against about £3,000 per annum on the existing track, and if, instead of relaying the track, the Corporation could adopt some type of railless car to be run at as low a cost as a tramcar, they would be able to save these capital charges. The present cost of 20 railless cars would be £48,000, and the expenditure per annum £2,950, to set against the minimum of £6,000 per annum capital charges on the renewed tramway track.

London.—L.C.C. Tramways.—At last Tuesday's meeting of the London County Council the following motion by Mr. J. D. Gilbert was accepted: "That it be referred to the Highways Committee to consider and report whether the tramways receipts would be increased if (*a*) the existing distances for all fares were increased; (*b*) half-penny fare tickets were re-introduced; (*c*) transfer and return tickets were re-instated, and (*d*) season tickets were introduced.

TELEGRAPH & TELEPHONE NOTES.

Afghanistan.—New Telegraph Line.—A contract for the erection of a telegraph line between Kabul and Kandahar has been given to a European firm, says *The Times.*

France.—Ships' Radio Apparatus.—A decree of April 6th, 1923, regulating radio-telegraphy on French ships became applicable also to foreign ships in French ports on October 6th, and is the latest regulation of radio communication in the interest of safety of life at sea. It is an adaptation of the requirements of the International Convention of 1914 for Safety of Life at Sea, and the French war requirements for wireless apparatus on ships. The decree provides that radio-telegraphic apparatus capable of transmitting and receiving signals at sea over a distance of at least 150 miles must be provided on all ships of 2,000 gross tons or more; on all ships of less than 2,000 tons, which carry 50 or more persons (crew included); and on all ships having more than 12 passengers on board. The minimum range exceeds the 100 miles minimum prescribed by the International Convention of 1914, the American law of 1910, the British law of 1919, and other laws, but it conforms to improvements in transmitting installations. The new decree requires all French merchant and fishing vessels of less than 2,000 gross tons, but over 500 gross tons, carrying less than 50 persons or less than 15 passengers, to be equipped with apparatus to receive messages, even though not equipped with transmitting apparatus. The French regulations, like the British, authorise competent authorities to exempt from the requirement to carry wireless apparatus ships in special service or on very short voyages.—*Commerce Reports.*

Greenland.—Radio Stations.—The Danish Government has decided upon the construction of radio stations in Greenland. They will be situated at Godhavn, on Disko Island; Godthaab, on the west coast of Greenland; Julianehaab, on the south coast; and the Angmagssauk, on the east coast.—*The Times.*

Hong-Kong.—Radio Communication During Typhoon.—During the recent typhoon at Hong-Kong, when great damage was done, the gale wrecked the masts of the local radio station at Cape d'Aguilar and also carried away the aerials of the naval station. In order to maintain the necessary radio communication with shipping while a temporary station was being erected at Cape d'Aguilar, the local Director of Public

Works asked permission from the Marconi Co.'s representative at Hong-Kong to utilise the Marconi equipment on vessels in harbour. This permission was readily granted, and communication was successfully maintained, first by the Marconi installation on the s.s. *Empress of Australia* and, on that vessel's departure from Hong-Kong, by the s.s. *Kut Sang*.

India.—High-speed Radio Station.—Good progress is being made with the erection of a high-speed radio installation to operate between Rangoon and Madras, and it is hoped that the scheme will be in working order before the end of the year.—*Indian Engineering.*

Irish Free State.—Radio Stations Wanted.—The Cork Chamber of Commerce has intimated to the Irish Free State Government that the erection of radio "broadcasting installations" was necessary and desirable at the Old Head of Kinsale, Eastnet Lighthouse, and for Rock Island, Skibbereen, off the Coast of Cork, with a view to the prevention of loss of life at sea, as well as for the benefit of the trade and commerce of Southern Ireland.

New Atlantic Cable.—Return of C.S. "Faraday."—The new cable steamer *Faraday*, belonging to Messrs. Siemens Brothers & Co., Ltd., of Woolwich, has returned from her maiden cable-laying expedition. She has successfully completed the laying of the section of cable connecting New York and Canso, Nova Scotia, about 1,000 miles, notwithstanding the fact that she encountered exceptionally bad weather, during which a mishap occurred to the cable, and the end was lost in 3,000 fathoms of water. The vessel here proved her excellent qualities as a cable steamer, as the end was recovered very quickly, and the whole section completed to the satisfaction of the engineers of the Commercial Cable Co., who have had it in continual use since laying. This section forms a part of the Commercial Cable Co.'s new cable connection between America and England, which will have the greatest traffic carrying capacity of any existing cable.

Rumania.—Projected Radio Station.—Business circles in Constantza are much interested in a projected radio telegraph plant. The present radio station at Constantza is used for little more than the distribution of shipping intelligence. Bankers and shippers generally want not only radio telegraph and telephone connection with Western Europe, but also with Constantinople, Piræus, and Odessa. The construction of such a station has secured the approval of the Ministers of Communications, Finance, and Industry and Commerce and, with a certain supply of German material now on hand, it is expected that the enterprise will soon take definite form at a cost of approximately 800,000 lei. Private business men volunteered to make up this total, to be returned to them later in the remission of taxes. The only cable service from Constantza is over the former German cable to Constantinople.—*Commerce Reports.*

Siam.—New Radio Stations.—Marconi plant is to be used for the new permanent radio station on the island of Kohsichang, where a temporary installation is at present in operation. The latter will probably be transferred to Phra Pradaeng when the new set has been installed. A long-distance receiving and dispatching station is also contemplated for Bangkok.—*Eastern Engineering.*

The Telephone Service.—New Kennford Exchange.—A new telephone exchange was recently opened at Kennford, situated four miles from Exeter, in the direction of Plymouth. The exchange, which will serve Kennford, Ken, and Exminster, is one of a series of 14 new exchanges that are to be opened in the extensive Exeter telephone district, which comprises the whole of Devon, except Plymouth, and Somerset.

Street Call Boxes.—Public street telephone call boxes are being erected in the Tottenham Court Road district of London.

Radio on Aircraft.—Telephony Demonstration.—At the air demonstration arranged for the Dominion representatives at Croydon Aerodrome on November 10th, Captain S. Baker, Civil Aviation Traffic Officer, described the organisation of aerial traffic and its control by means of radio and other signalling systems. A demonstration of the methods employed in the daily routine of the aerodrome was given by means of the Marconi Company's aeroplane, which represented a commercial machine flying on the Continental air route, and two Marconiphone loud-speakers which were arranged near the control tower in such a manner that the orders given to the aeroplane and the pilot's replies could easily be followed by the whole gathering. The machine was called as it would be in the ordinary way when over one of the reporting points, such as Biggin Hill. The pilot asked for a bearing, which was given, and the machine flew on that bearing until it reached the aerodrome. Directions for landing were given as would be done if the ground were enveloped in fog. After the landing, the Imperial representatives examined the Marconi telegraph and telephone apparatus on the aeroplane, by means of which conversation has been carried on between a pilot and the aerodrome, under favourable conditions, up to as great a distance as 400 miles.

Turkey.—Long-distance Telephony.—Long-distance telephone communication has been established between Constantinople and Smyrna, and an additional line between Broussa and Angora is under consideration. The service is administered by the Constantinople Telephone Co.—*Commerce Reports.*

RADIO NOTES.

Radio-Broadcasting.—Advisory Committee.—At a luncheon given by the National Association of Radio Manufacturers following the inauguration of the Wireless Exhibition, the Postmaster-General gave a forecast of the lines along which the Post Office considered that development would proceed, and announced that he was about to appoint a Broadcast Advisory Committee, composed of representatives of the industry, the public, and the Press, so that future Postmasters-General would not have to carry the whole burden on their shoulders.

Licences.—He also said that in March this year there were 122,000 broadcast licences current; in September there were 180,000, and in October 236,000 more licences were issued, mostly of the 15s. variety, with the result that there were now 492,000 licences in existence.

Sheffield Relay Station.—The official opening of the Sheffield relay station, the first in the country, takes place to-day (Friday), the Lord Mayor and the Master Cutler taking part, as well as Mr. J. C. W. Reith, director and manager of the British Broadcasting Co.

Broadcast Theatrical Plays.—It is proposed to erect a transmitting station at the "Old Vic" theatre (the home of Shakespeare's plays), for the purpose of relaying performances to 2LO, whence they will be broadcast in the usual manner. The wave length of the "Old Vic" transmitter will be so unusual and will be changed so frequently that it will be difficult for amateurs to tune in to it directly.—*Daily Mail.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the* Electrical Review *in which the "Official Notice" appeared in our advertisement pages.)

OPEN.

Australia.—Sydney.—City Council. January 7th. Coal-unloading and conveying plant.*

Melbourne.—December 19th. Victorian Railway Commissioners. Fibre for insulators.

Belfast. — November 19th. Electricity Department. Steam, water, and other piping, &c., at the Harbour power station. (November 2nd.)

December 18th. Board of Guardians invite schemes for the installation and equipment of a centralised heating and lighting plant. (See this issue.)

Birmingham.—November 21st. Public Works Committee. Construction of 700 yards double-track tramway and about 3,000 yards of wooden-sleeper construction double-track tramway in Bristol Road and Lickey Road. Mr. H. H. Humphreys, city engineer, Council House, Birmingham.

Croydon.—November 28th. Electricity Department. One 50,000-lb. steam-raising unit. (See this issue.)

Dublin.—November 19th. Dublin United Tramways Co. (1896), Ltd. Stores for six months, including electric lamps, electrical fittings, &c. (November 9th.)

Dundee.—November 22nd. Electricity Department. Single- and three-core l.p. paper-insulated lead-sheathed cable. (November 9th.)

Edinburgh.—November 19th. Electricity Supply Department. Five 3-phase transformers. (November 9th.)

December 4th. Tramways Department. Tramway cars, trucks, and electrical equipment. Tramways manager, 2, St. James' Square, Edinburgh.

Finland.—Helsingfors.—November 22nd. Finnish Ministry of War. 10,000 kg. h.d. tinned-steel wire for field telephones.*

Glasgow.—November 20th. Tramways Department. Six months' supply of stores. Mr. James Dalrymple, general manager, 46, Bath Street, Glasgow.

January 16th. Cleansing Department. Tenders and designs for refuse disposal works at Govan. (See this issue.)

Govan.—November 23rd. Combination Parish Council. Installing electric lighting at the Southern General Hospital. Mr. John Mitchell, clerk, 7-8, Carlton Place, Glasgow.

Greenock. — December 8th. Electricity Department. Three 3,000-kVA transformers, h.p. switchgear, transformers with boosters, and induction regulators. (See this issue.)

Ince-in-Makerfield. — November 30th. Urban District Council. Diesel oil engine driving bore hole and horizontal pumping sets, in duplicate. (See this issue.)

India.—DELHI.—January 21st. Public Works Department. Turbo-alternator set, condensing plant, cranes, boiler-house plant, economiser, steel chimney, pipework, switchboards, converters, sub-station plant, e.h.p. feeder cables and accessories. Specification, &c., from the Chief Controller of Stores (Engineering Section), Indian Stores Department, Delhi, on payment of Rs. 20 per set of two copies (extra copy Rs. 10).—*Reuter's Trade Service* (Delhi).

BOMBAY.—December 17th. One motor-driven air compressor. Deputy Executive Engineer, Mechanical Branch, Municipal Workshops, Foras Road, Bombay.—*Reuter's Trade Service* (Bombay).

Liverpool.—November 23rd. Tramways Department. Supply of tramway materials. Steel tramway rails and fishplates, steel fishbolts, steel tiebars, copper bonds, timber sleepers, and steel spikes. City Engineer, Municipal Buildings, Dale Street.

London.—PADDINGTON.—November 23rd. G.W. Railway. Stores, including telegraph instruments, cables, wires, lamps, apparatus, &c. (November 2nd.)

INDIA STORE DEPARTMENT.—November 29th. Switchboard cable and v.i.r. insulated wire. (November 9th.)

November 30th. Sulphate of copper.

ST. PANCRAS.—December 6th. Electricity Department. One vertical electric motor-driven condensing-water pump, capacity 750,000 gallons per hour. (See this issue.)

Manchester. — November 21st. Markets Committee. Electrical drive for ammonia compressor at Elm Street cold stores. A. Chadwick, general superintendent, Markets Department, Town Hall.

Newcastle-under-Lyme.—November 20th. Electricity Department. 500 yd. .10, .04, .10 l.p. paper-insulated lead-covered steel-armoured distributor. (November 9th.)

New Zealand.—AUCKLAND.—November 24th. Electric Power Board. Transformers and accessories.*

Porthcawl (Glam.).—The Urban District Council is prepared to grant facilities for the installation and operation of an electricity supply scheme (public company) within its district. (See this issue.)

Preston.—November 26th. Electricity Department. Two 150-kW rotary converter equipments, h.p. and l.p. switchgear, h.p. cables. (November 2nd.)

Reigate.—November 21st. Town Council. Electrically-driven drainage pumps. (November 9th.)

Rhyl.—November 27th. Electricity Department. Laying new mains, with control switchgear, certain new lamp columns, lamp heads, fittings, time switches, &c. (See this issue.)

South Africa.—CAPE TOWN.—December 10th. South African Railways and Harbours Blockyard plant, Table Bay Harbour Breakwater extension, 3 electrically-driven concrete mixers, 2 electrically-driven stone elevators, 2 electrically-driven sand elevators, 1 electric lift for cement, &c. Particulars from High Commissioners of the Union of South Africa, Trafalgar Square, W.C.

GRAAF-REINET.—December 20th. Municipal Council. Crude oil engines, generators, and street equipment. Specifications and particulars from the Town Clerk, Town Office, Graaf-Reinet.

Southampton.—December 3rd. Electricity Department. Two e.h.p. switch cubicles with control panels and indicating diagrams, &c. (See this issue.)

Spain.—November 30th. The Zumarraga-Zumaya Railway Co., San Sebastian. Material required for the electrification of the railway between the two towns mentioned.

Uruguay.—MONTEVIDEO.—December 27th. State Electric Light Works. Electrical supplies, including cable, insulating compound, lamp shades, &c.*

Warrington.—November 19th. Electricity Department. Medium-pressure paper and lead-covered cables and m.p. rubber-covered cables. (November 9th.)

November 20th. Cheshire Lines Committee. Stores, including telegraph materials, for 12 months. Stores Superintendent, Cheshire Lines, Warrington.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Commonwealth Post and Telegraph Department. Accepted:—

Telephones.—British Ericsson Telephone Manufacturing Co. (Melbourne, (about £57,000).
Main distributing frames.—Western Electric Co. (Australia), Ltd. (about £4,250).
Terminal cables.—George Neal Co. (£2,716).
Cables.—British Insulated & Helsby Cables, Ltd. (£64,000).
Brass condenser tubes.—Broughton Copper Co., Manchester (£3,697).
Bronze wire.—Frederick Smith & Co. (£5,628).
Telephone equipment.—British General Electric Co., Ltd. (£6,602).
Copper wire.—British Insulated & Helsby Cables, Ltd. (£4,907).

The Victorian State Electricity Commission. Accepted:—

Underground cables, joint boxes, &c., Siemens Bros. & Co. (£7,355); circulating water screens, travelling type, F. W. Brackett & Co., Colchester (£2,850); copper wire, British Insulated & Helsby Cables, Ltd. (£12,841); transformers, Foster Engineering Co., London (£1,063).

Victorian State Railways Department. Accepted:—

Electric storage battery industrial truck, Electromobiles, Ltd. (£503). —*Manchester Commercial.*

Belgium.—The New Antwerp Telephone and Electrical Works Co., of Berchem, Antwerp, last week submitted the lowest tender to the Belgian Post and Telegraph authorities for the supply and erection of the necessary instruments at the new head telephone exchange in Mons.

Douglas (Isle of Man).—Town Council. Accepted:—

Two 6-cylinder Ruston vertical cold-starting oil engines, 660 b.h.p. (£12,000), and for taking out the existing horizontal engines and replacing them with two 4-cylinder vertical oil engines, 440 b.h.p., and rewinding two existing dynamos (£2,250).—Ruston & Hornsby.

Faversham.—Rural Council. Accepted:—

Installing electric lighting at Beacon Hill Hospital.—H. S. Tett & Co., Ltd.

Hastings.—Town Council. Accepted:—

Installing electric lighting at St. Clement's Caves (£198).—Guild of Engineers.

Hazel Grove and Bramhall.—Urban District Council. The following contracts have been placed:—

Electric cables and services (£21,747).—W. T. Glover & Co.
Electric meters (£728).—Ferranti, Ltd., Hollinwood.
Sub-station switchgear (£565).—Ferguson, Pailin, Ltd.

Maidenhead.—Town Council. Accepted:—

Oil fuel for the electricity works for a year (at £4 17s. 6d. per ton).—British Petroleum Co., Ltd.

Maidstone.—Town Council. Accepted:—

3,000-kW Ljungström turbo-generator (£16,030).—Brush Electrical Engineering Co., Ltd.

Malvern.—Urban Council. Accepted:—

Switchgear for extensions to the electricity works (£1,028).—Ferguson, Pailin, Ltd.

Northampton.—Tramways Committee. Accepted:—

Covered-in tops for three tramcars (£240 each).—Brush Electrical Engineering Co., Ltd.

Russia.—Contracts have been placed in connection with the new power station at Nijni-Novgorod. Three 10,000-kW turbo-generators, with condensers, transformers, and switchgear, are to be provided by the Metropolitan-Vickers Electrical Co., Ltd., of Trafford Park, Manchester. The Erste Brünner Maschinenfabric, Czecho-Slovakia, will also provide turbo-alternators, while Messrs. Babcock & Wilcox, Ltd., will supply the boilers. It is understood that the Trafford Park portion of the contract amounts to £600,000.—*Manchester Guardian Commercial.*

FORTHCOMING EVENTS.

Institution of Civil Engineers.—Tuesday, November 20th. At the Institution, Great George Street, S.W. At 6 p.m. Ordinary meeting.

Institute of Marine Engineers.—Tuesday, November 20th. At the Institution, The Minories, Tower Hill. At 6.30 p.m. Paper on "The Gas Turbine," by Mr. H. Campbell.

Institution of Production Engineers.—Wednesday, November 21st. At the Engineers' Club, Coventry Street, W. At 7.30 p.m. Paper on "The Use of Charts in Engineering," by Mr. A. W. Swan.

Association of Consulting Engineers.—Wednesday, November 21st. At St. Stephen's Club, Victoria Embankment, S.W.1. At 7 for 7.30 p.m. Dinner.

Commercial Motor Exhibition.—At Olympia, W. November 22nd to December 1st.

Public Works, Roads, and Transport Congress and Exhibition.—At the Royal Agricultural Hall, Islington, N. November 22nd to November 29th.

Institution of Electrical Engineers.—Thursday, November 22nd. At the Institution, Victoria Embankment, W.C. At 6 p.m. Joint meeting with the British Section of the Société des Ingénieurs Civils de France. Paper on "The Electrification of the Midi Railway," by Mr. A. Buchellery.

INFORMAL MEETING.—Monday, November 19th. At the Institution, Victoria Embankment, W.C. At 7 p.m. Discussion on "Power in Telephone Exchanges," to be opened by Mr. A. B. Eason.

(Mersey and North Wales (Liverpool) Centre).—Monday, November 19th. At the University, Liverpool. At 7 p.m. Paper on "Industrial Research," by Mr. W. Wilson.

(North-Western Centre).—Tuesday, November 20th. At the Engineers' Club, Albert Square, Manchester. At 7 p.m. Paper on "The Drive of Power-station Auxiliaries," by Messrs. L. Breach and H. Midgeley.

(East-Midland Sub-Centre).—Tuesday, November 20th. At Loughborough College. At 6.45 p.m. Paper on "Electric Control," by Dr. C. C. Garrard.

(Wireless Section).—Wednesday, November 21st. At the Institution, Victoria Embankment, W.C. At 6 p.m. Papers on "Periodic Trigger Reception," by Messrs. E. V. Appleton and F. S. Thompson; and on "A Dynamic Model of a Valve and Oscillating Circuit," by Mr. R. C. Clinker.

(Sheffield and District Sub-Centre).—Wednesday, November 21st. At the Royal Victoria Hotel, Sheffield. At 7.30 p.m. Paper on "The Manufacture of Seamless Steel Tubes and Cylinders," by Mr. A. R. Chaytor.

Manchester Electro-Harmonic Society.—Friday, November 23rd. At the Albion Hotel, Piccadilly, Manchester. At 7.30 p.m. Concert.

Birmingham and District Electric Club.—Friday, November 23rd. At the Grand Hotel, Colmore Row, Birmingham. At 7 p.m. Paper on "Storage Batteries," by Dr. McKinnon.

Junior Institution of Engineers.—Friday, November 23rd. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette, "Technical Arbitrations," by Mr. W. A. Tookey.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

Requests for information must be accompanied by a stamped addressed envelope.

We should be glad to learn the names and addresses of makers or suppliers of :—

Rheotan wire.

Ebonite scrap.

Pulleys (straight and angle type, mounted on brackets) for signal wire as used in railway work.

NOTES.

Concert.—The 10th annual charity concert promoted by the Bradford Corporation Tramways Ambulance and Nursing Divisions took place at St. George's Hall on November 7th, when the great hall, seating over 3,000 persons, was crowded, and an excellent programme presented.

Hydro-Electric Equipment for Canada.—In a report upon recent commercial and industrial conditions in Canada by H.M. Trade Commissioner at Toronto, reproduced in the *Board of Trade Journal*, it is stated that a number of large orders for hydro-electric equipment have been placed during the past few months. Those British firms who have local branches or representatives in Canada have been active in seeking, and, in some cases, successful in securing the business. Orders for a considerable sum were secured by a Swedish firm. A Canadian firm has obtained an order for 12 water wheels for a hydro-electric enterprise in Quebec Province, valued at nearly $2,000,000. The same firm is building two large electrical generators, the contract price being about $1,000,000. New business is likely to be offered as a result of the development of the pulp and paper industry. Discussion of the electrification of railway lines foreshadows heavy expenditure on equipment account.

Royal Institution.—The 98th course of juvenile lectures at the Royal Institution, to be delivered this Christmas by Sir William Bragg, F.R.S., is entitled "Concerning the Nature of Things," and will deal with: I, The Atoms of which Things are Made; II, The Nature of Gases; III, The Nature of Liquids; IV, V, and VI, The Nature of Crystals; (*a*) Diamond; (*b*) Ice and Snow; (*c*) Metals. The first lecture will be given on Thursday, December 27th, 1923, and the succeeding ones on December 29th and January 1st, 3rd, 5th and 8th, 1924.

Appointments Vacant.—Distribution superintendent, for the Paisley Corporation electricity department; chief clerk and mains assistant, for the Torquay Corporation electricity works; assistant electrical engineer (£250 plus bonus = £369), for service in England, for the High Commissioner of India; electrical engineer, for the Holmfirth Urban District Council electricity undertaking; plumber-jointer for the Stepney Corporation electricity department. (See our advertisement pages to-day.)

"Beama" Scholarships.—The Council of the British Electrical and Allied Manufacturers' Association (Inc.) has recently granted the following scholarships, tenable for one year, each of the value of £100, and the payment of college fees. Electrical and Mechanical Engineering: J. D. Cockcroft, tenable at Cambridge University; A. F. Everest, tenable at Birmingham University. Electrical Engineering: G. K. Franklin, tenable at Manchester College of Technology; G. S. C. Lucas, tenable at City & Guilds (Eng.) College, South Kensington; R. C. Matthews, tenable at City & Guilds (Eng. College; H. L. McBroom, tenable at the Royal Technical College, Glasgow; J. L. Orme, tenable at Birmingham University; C. W. Richards, tenable at City & Guilds (Eng.) College; R. Wright, tenable at the City & Guilds (Eng.) College. Mechanical Engineering: J. W. Davison, tenable at Manchester College of Technology; M. Geddes, tenable at Glasgow University; I. H. Hedley, tenable at Durham University; H. C. Lack, tenable at Manchester College of Technology; A. Layland, tenable at Manchester College of Technology; B. S. Pelton, tenable at London University.

Parliamentary.—Parliament re-assembled on Tuesday, November 13th. The Prime Minister announced the same afternoon that the Dissolution would take place to-day (Friday).

Electricity Commissioners' Costs.—Sir James Remnant asked the Parliamentary Secretary to the Ministry of Transport if his attention had been called to the case of the King *v.* the Electricity Commissioners, in the Court of Appeal, on July 27th, 1923, in which judgment, with costs, was given against the Commissioners, and in favour of the London electricity companies; and, if so, would he see that these costs were not included amongst the ordinary expenses which the Electricity Commissioners were allowed under Act of Parliament to levy upon the companies.

Lieut.-Col. J. T. C. Moore-Brabazon said that Section 29 of the Electricity (Supply) Act, 1919, as qualified by Section 7 of the Electricity (Supply) Act, 1922, was mandatory and precluded any differentiation of expenses. Costs against the Commissioners in an action were properly to be included as expenses of the Commissioners.

Sir James Remnant asked whether there was any limit to the expenses and costs of the Commissioners in the making of a charge against the electricity companies by the Commissioners.

Lieut.-Col. J. T. C. Moore-Brabazon.—I think not.

The Lord Mayor's Show.—The show this year was largely devoted to a representation of the progress of British industry through the ages. The electrical industry was represented by a car provided by the British Electrical Development Association. In view of the difficulty of dealing with so large a subject, and particularly of using attractive lighting schemes in the day-time, the car represented the progress of the art of cookery, showing, in comparison with the early methods of preparing food with the crudest implements over an open fire, the modern and rapidly developing use of electrcity in the kitchen. The electric cooker, in operation during the progress of the car along the route, was supplied with energy from an Exide battery carried on the vehicle. Apart from this display and supporting features of sundry electrical appliances

of general use and value, the vehicle itself was propelled electrically, being, in fact, one of the latest types of heavy electric lorry, with tipping mechanism. The E.D.A. acknowledges the kind and prompt assistance received in getting this display together at such short notice from: The Metropolitan Borough of Hackney, for the loan of the electric vehicle; Mr. L. L. Robinson and his staff, for wiring and attention given; The Chloride Electrical Storage Co., Ltd., for the loan of battery; and the British Electric Transformer Co., for adapting a Hackney cooker to the voltage available and for the assistance of a demonstrator. In addition, the procession included a car carrying a model of the British Empire Exhibition, 1924, and another representing the "Wireless Concert Band" from the many trumpets of which issued music broadcast from 2LO.

A Lighting Demonstration.—On the 5th inst., the third-year students of electrical engineering of the Regent Street Polytechnic School of Engineering attended an industrial and domestic lighting demonstration at the British Thomson-Houston Co.'s Lighting Service Department's demonstration rooms. The party was conducted by Mr. Phillip Kemp, M.Sc., M.I.E.E., and Mr. W. Millner, B.Sc., A.M.I.E.E., illuminating engineer of the B.T.H. Co., demonstrated various industrial lighting effects, commencing with obsolete local lighting, consisting of carbon-filament lamps and enamelled iron shades, a replica of the system still unfortunately in use in many industries, and concluding with the design of the ideal system of illumination in which glare is conspicuous by its absence, and the light is perfectly diffused. The demonstration was very much appreciated by the visitors who, although perfectly well aware of the progress made during recent years in the efficiency of the modern gasfilled lamp, were greatly interested in its application to industry. Domestic lighting effects were also demonstrated, the decorative and charming effects produced by artistic designs upon glassware and silk-covered shades being appreciated.

The Electro-Harmonic Society.—The concert last Friday (Ladies' Night) was very successful, the programme being well organised and the performance of the artistes admirable. The attendance might have been better, there being several vacant seats. Mr. Bernard Flanders's pianoforte solo in the second part was enthusiastically applauded, and the songs of Miss Barbara Samuel and Mr. David Evans were particularly pleasing.

Local Engineering Society.—A paper on "The Lesser-Known Electrical Utilities" was read by Mr. James Orr at a recent meeting of the Paisley Association of Electrical Engineers. The author dealt with a variety of matters, ranging from ship steering to pyrometry, and touched upon "daylight" illumination, mercury arc rectifiers, &c.

Large Indian Hydro-Electric Contracts.—*The Industrial Daily News* reports that, in connection with the new 87,500-h.p. hydro-electric scheme in the Western Ghats, Bombay State, contracts will be placed in this country in the near future for the generating plant, switchgear and other material. The machinery to be installed, all of which will be manufactured in British works, includes five pairs of water wheels, each of 30,000-h.p. capacity, five 17,500-kW generators, two exciter water-wheels and dynames, and complete switch and distribution gear. Twelve transformers of 9,000 kW and 12 of 8,000 kW, sub-station switchgear, condensers and cables, and a 125-ton travelling crane for the main power house are also to be ordered. The current from the new power station will be conveyed by a high-pressure transmission line to Bombay, where it will be employed to drive cotton mills, engineering works and for railway and other purposes. The Treasury has guaranteed £1,000,000 towards the carrying out of the undertaking, under the terms of which all contracts have to be placed subject to the approval of the British Government.

International Tramways Union.—The Highways Committee of the London County Council, being of the opinion that the advantages derived from membership of the International Tramways Union are not commensurate with the amount of subscription payable, advises the Council to withdraw from the Union as from the end of the present year.

Unemployment.—The number of persons on November 5th, 1923, recorded on the registers of the Employment Exchanges in Great Britain was 1,244,000. This was 11,996 less than in the preceding week, and 241,878 less than the figure recorded on January 1st, 1923. The total included 936,400 men, 40,700 boys, 230,000 women, and 36,900 girls. In addition, the number working systematic short-time and drawing benefit for intervals of unemployment was 62,200 on November 5th, as compared with 65,108 on October 29th and 56,261 on January 1st, 1923.—*The Times.*

The Industrial Welfare Society.—The Society held a conference on superannuation at the Hotel Victoria on Wednesday last, when a number of prominent men, including Sir Robert Kindersley, C.B.E., Col. P. D. Ionides (managing director of Messrs. Ransomes & Rapier, Ltd.), Sir Wm. Schooling, K.B.E., and Mr. Duncan Fraser (actuary, Royal Insurance Co.), spoke on various aspects of the subject. The Duke of York sent a message regretting his inability to be present.

INSTITUTION NOTES.

Institution of Electrical Engineers.—Joint Meetings.—The joint meeting with the Société des Ingénieurs Civils de France (British Section), which was to have been held on November 15th, has been postponed to November 22nd, at 6 p.m.

The joint meeting with the Physical Society of London on November 29th, 1923, will be in two sessions, *viz.*, 5.30 to 7 p.m. and 8 to 9.30 p.m. By permission of the British Broadcasting Co. arrangements are being made for parties, limited to 20 in number, to visit the company's studio at 2, Savoy Hill at half-hourly intervals from 3 to 5 p.m. Members wishing to visit the studio are requested to send their names to the secretary of the Institution and to indicate the time which would be most convenient to them.

Informal Meeting.—On November 5th Mr. A. F. Harmer was in the chair at the opening meeting of the Informal Section when the president (Dr. A. Russell) opened a discussion on "Engineering Training." He said it was agreed that a student's training should be practical and theoretical, but the difficulty was to determine how long each section should last. The defect of systems was that they were apt to ignore the human factor. The idea of raising the status of the profession by stiffening the examinations was wrong. Clever boys were often eccentric and unable to pass examinations creditably, and he hoped someone would suggest an alternative to examinations.

Lieut.-Col. W. A. J. O'Meara thought the engineering profession had not attained the status it deserved largely because anyone might term himself an engineer, which in many foreign countries was not allowed.

Mr. P. M. Baker had a collection of lantern slides showing views of training-school workshops in India and in England. He advocated that workshop training should follow as closely as possible the actual routine of business. In examinations the Indian could beat the European very easily by his ability to memorise whole volumes of principles and data.

Prof. C. L. Fortescue called attention to the remarkable sectionalisation of engineering. Psychology should be taught to salesmen, and to production men a knowledge of physiology and the muscular powers of operatives was valuable.

Dr. R. M. Walmsley said that the tendency was to modify examinations. Engineering training consisted of fundamentals that all engineers must know.

Dr. F. T. Chapman said that the old system of five years' apprenticeship was no longer adequate. A very successful method for training one grade of engineer was apprenticeship combined with eight hours or so of day-school training per week. Long periods of bench and lathe training were not essential for higher-grade engineers.

Mr. W. Day, Mr A. W. Berry, Major T. Rich, and Mr L. W. Phillips also spoke.

Institution of Heating and Ventilating Engineers.—Assistant's Prize Competition.—The Council of the Institution is offering a Lumly premium (ten guineas) for the best paper submitted dealing with heating in the generally-accepted sense of the term; a Sirocco premium (ten guineas) for the best paper dealing with fan engineering and the general application of fans, air washing and conditioning, and dust and fume removal, &c.; and a Preston premium (five guineas) for the next best paper on either of the above-named subjects. The papers must be submitted during 1924, and must be the sole composition of an "assistant."

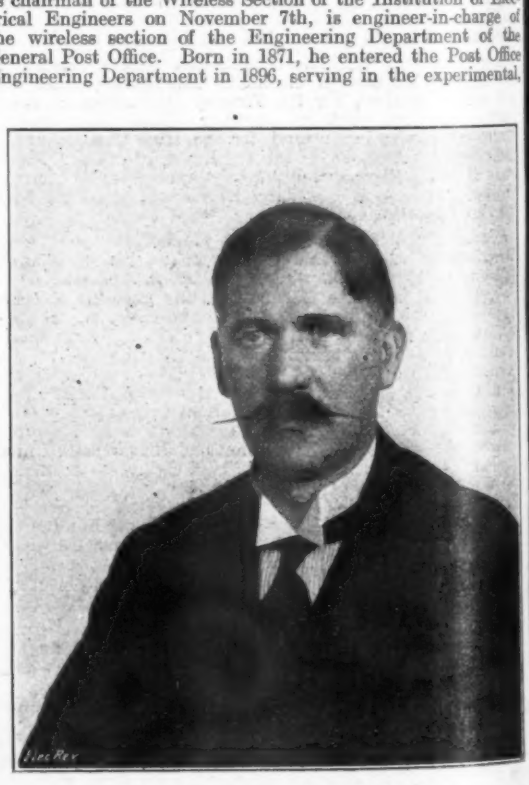
Faults in Fan Design.—The first of the informal 1923-24 sessional meetings arranged by the Institution was held at the Engineers' Club, London, on November 7th, when a paper was read by Mr. Fredk. G. Whipp, A.M.I.Mech.E., entitled "Some Common Faults in Fan Design."

Institution of Civil Engineers.—President's Address.—In his inaugural address Sir C. Morgan departed from the common practice of dealing with some scientific or technical topic, and discussed the future prospect of engineers. He admitted that there were apparent reasons for temporary discouragement, but enumerated the grounds on which he based the opinion that there was no need to think darkly of the future. With regard to transport, he pointed out that the high efficiency of steam locomotives and their elasticity under load made him view with very considerable doubt the desirability of the application of electric traction to main-line traffic as a commercial proposition.—*The Times.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Mr. E. H. Shaughnessy, O.B.E., who delivered his address as chairman of the Wireless Section of the Institution of Electrical Engineers on November 7th, is engineer-in-charge of the wireless section of the Engineering Department of the General Post Office. Born in 1871, he entered the Post Office Engineering Department in 1896, serving in the experimental,



Mr. E. H. Shaughnessy, O.B.E.

testing, telegraph and cable sections, and specialising on underground and submarine cables. He also served as a cable engineer in 1895 on the s.s. *Faraday* during the laying of a submarine cable in the Gulf of Mexico and in the repair of other cables. After five years in the provinces on construction and maintenance work in connection with telegraphs and tele-

shores, he returned to London in 1913 to take up his present position. Mr. Shaughnessy was also responsible for the reconstruction of the ship and shore coast radio stations and for the design and construction of stations at Leafield, Cairo, &c. He has for many years lectured on telegraphy, telephony, &c., at various London technical institutes. He is a member of the Radio Research Board, and was one of the British delegates to the Inter-Allied Technical Committee on Radio-Telegraphy in Paris in 1921; he is also a member of the National Committee of Scientific Radio-Telegraphy and was a delegate to the International Research Union at Brussels, 1922. Other posts filled by Mr. Shaughnessy are those of vice-president of the Radio Society of Great Britain and examiner in telegraphy for the City and Guilds of London Institute; and he is a member of several committees and panels of the British Engineering Standards Association.

Alderman G. Billington has been reappointed chairman of Salford Corporation Electricity Committee, and Alderman J. Rothwell deputy-chairman.

Mr. A. de V. Leigh, M.B.E., M.A., has been appointed secretary of the London Chamber of Commerce in succession to the late Mr. Charles E. Musgrave.

Mrs. Underwood and her family wish to convey their thanks to the large number of business friends of the late Mr. Wm. G. Underwood who have so kindly sympathised with them in their bereavement.

Alderman J. B. Burman has been re-elected chairman of the Birmingham Corporation Electric Supply Committee.

We are informed that Mr. E. J. Christian, M.I.Mech.E., has joined the board of Messrs. Sutcliffe Bros. & Bryce, Ltd., of Globe Works, Hyde, and has been appointed general manager.

In connection with the electrification of the South African railways, Mr. George G. Terry, who has been with the Hydro-Electric Power Commission of Ontario for 15 years as superintendent of lines, has arrived at Johannesburg on leave in order to assist the South African railway administration in this work.—*Times Trade Supplement.*

Sunderland Town Council has presented the honorary freedom of the borough, together with a gift of plate, to Alderman Wm. Bruce, one of the oldest members of the Corporation. He was for 16 years chairman of the Electricity Committee, retiring in 1919 owing to ill-health.

Mr. H. A. S. Mugford, electrical engineer, has been re-elected a member of the Croydon Town Council, and Mr. L. F. Christy, electrical engineer, has been re-elected a member of the Chelmsford Town Council.

Obituary.—M. Maurice Leblanc.—In our issue of November 2nd we announced, with regret, the death of M. Maurice Leblanc, which took place on October 27th. M. Leblanc was born at Paris in 1857, and after preliminary training entered the service of the Compagnie des Chemins de fer de l'Est, which placed him in charge of a variety of technical investigations. In 1886 he joined an industrial company, but soon left it, having no taste for either administrative or commercial work. In fact, he used to say with pride that in spite of the offers made to him, he had never been either an administrator or a manufacturer, but had devoted himself to invention. In this capacity he was exceptionally able and successful. He made a special study of alternating-current phenomena and apparatus, and achieved so wide a reputation that in 1897 the American General Electric Co. offered him the office of engineer-in-chief, but he was unable to accept it. Again, after the Exposition of 1900, the A.E.G. invited him to become its chief electrician, but he declined the honour. In the following year Mr. George Westinghouse bought his patents on behalf of the American Westinghouse and General Electric Companies, and appointed him consulting engineer to the newly-founded French Westinghouse Co., to which he remained attached. It is said that the purchase of his patents was made in order to prevent their utilisation; for if any other important concern had made use of them, the American companies would have been compelled to follow suit, and to scrap their then existing standards at heavy cost.

One of M. Leblanc's most cherished aims was to develop a simple form of domestic refrigerator or cooler, in order to render life in the tropics more bearable to Europeans. This aspiration involved him in a very wide range of investigations, including the study of condensers, steam ejectors, and machinery running at extremely high speeds. The outbreak of war diverted his inventive faculties to the means of national defence; he took part in the invention of a trench mortar, and developed a new aeroplane engine. Latterly he proposed to use high-frequency currents for the propulsion of railway trains in the manner described in our issues of September 8th and 15th, 1922.

M. Leblanc was elected an Honorary Member of the Institution of Electrical Engineers in 1915, and the first member of the newly-formed Industrial Section of the Académie des Sciences in 1918. We are indebted for the foregoing particulars to the *Revue Générale de l'Electricité*, of whose editing committee M. Leblanc was one of the vice-presidents.

Mr. Frederick L. Rawson.—On Saturday last Mr. F. L. Rawson, M.I.E.E., died in New York from pneumonia. He was trained as an engineer, and, being endowed with exceptional ability and an engaging personality, he might have had a brilliant career. Unfortunately fate willed otherwise, and his name was associated mainly with speculative ventures which ended in disaster. The firm of Woodhouse & Rawson, electrical engineers, was the *alma mater* of many electrical engineers who now occupy positions in the front rank of their profession, and under happier auspices might well have been to-day one of the world's leading electrical concerns; it was responsible for some excellent achievements before it came to grief. The Elmore copper-depositing companies, of which Mr. Rawson became managing director and engineer, suffered the same fate, which, indeed, overwhelmed all his undertakings, except that which he set up during the war and was carrying on up to the time of his death—namely, the profession of "spiritual healing"—of which the less we say the better.

The Times of Saturday last contained the following announcement:—"The funeral of the late Dorothy May Rodgerson-von Siemens took place on October 26th, at the cemetery in Baden Baden. She was the only daughter of the late Rev. W. P. Rodgerson, B.Sc., Lasswode, and second wife of Werner F. von Siemens, late of 36, Berliner-strasse, Charlottenburg, Berlin."

Mrs. Hepworth-Collins.—We regret to notice in *The Times* the announcement of the death, following an operation, of the wife of Mr. W. Hepworth-Collins, for many years a director and the secretary of the Corona Lampworks. The deceased lady, who was in the prime of life, was the eldest daughter of the late Hon. C. S. Dick-Melbourne. She was an amateur musician of great distinction, having been trained in Paris, Milan, and Florence, and her loss will be widely felt.

Mr. W. H. Cripps.—We record with regret the death of Mr. William Harrison Cripps, F.R.C.S., which occurred on November 8th at 19, Bentinck Street, London, W.1. Mr. Cripps, who was a man of distinction in his special profession—surgery—was highly gifted in a business sense as well. His qualities in this latter connection will be especially remembered by those who were in any way connected with the Metropolitan Electric Supply Co., Ltd., in its earlier years, whether as shareholders, officials, or as parties to the negotiations for the sale of the company's Marylebone undertaking to the Marylebone Borough Council. We can recall few more capable and courteous chairmen of electrical company meetings. His grasp of affairs was only excelled by the geniality with which he conducted the proceedings, and in the negotiations for the sale to the Marylebone Council his services must have been of great value to the Metropolitan Co. He was 73 years of age.

NEW COMPANIES REGISTERED.

Godfrey Salmon, Ltd. (193,561).—Private company. Registered November 5th. Capital, £500 in £1 shares. To adopt an agreement with G. Salmon and to carry on the business of electrical and wireless engineers as formerly carried on by the said vendor at 33, Grafton Street, Tottenham Court Road, W.1. The first directors are:—G. Salmon, 33, Grafton Street, Tottenham Court Road, W.1, electrical engineer; H. A. Atkins, 5, Henry Street, Upper Kennington Lane, S.E. Qualification, £50. Remuneration, £50 each per annum (chairman £75). Secretary: J. Scott, 46, High Street, Notting Hill Gate, W.11. Registered office: 33, Grafton Street, Tottenham Court Road, W.1.

Electronic Devices, Ltd. (193,559).—Private company. Registered November 5th. Capital, £6,000 in £1 shares. To adopt an agreement with J. R. Robertson, to introduce, operate, exploit, and deal with inventions, methods, and processes relating to apparatus for recording and reproducing optical images and sound vibrations, electronic valves for controlling mechanisms at a distance through wireless and other waves, devices for projecting radio vision views or wireless pictures, &c., and to acquire, import, export, manufacture, and deal in all things necessary or incidental to the above. The first directors are:—H. T. Morphy, 34, FitzJames Avenue, West Kensington, W.14, director and president, International Development Corporation, of Delaware, U.S.A., and director of British International Industries, Ltd.; S. W. Kendall, 68, Talgarth Mansions, W.14, chemical engineer, vice-president of above American Co. and director of same British Co.; J. R. Robertson, Cedars Mansions Hotel, Gunterstone Road, W.14, engineer. Registered office: Kingsway Chambers, 44-6, Kingsway, W.C.

Carlisle, Wiles & Co., Ltd. (193,556).—Private company. Registered November 5th. Capital, £7,000 in £1 shares. To acquire the business of manufacturers of special electric steel now carried on at Iona Steel Works, Penistone Road, Sheffield, as "Carlisle, Wiles & Co." The first directors are:—G. C. Carlisle, 21, Lawson Road, Sheffield; Margaret E. Carlisle, 21, Lawson Road, Sheffield; S. T. Wiles, 629, Penistone Road, Sheffield; T. Mann, Tongs Lane, Preesall, Lancs. Qualification, £500 shares. Secretary: S. T. Wiles. Registered office: Iona Steel Works, Penistone Road, Sheffield.

A. E. Tribe & Co., Ltd. (195,541).—Private company. Registered November 3rd. Capital, £1,000 in £1 shares. To carry on in the United Kingdom or elsewhere the business of electrical, motor, and general engineers, manufacturers of, and dealers in machinery, founders, tool makers, &c. The subscribers (each with one share) are:—W. Bainer, Broad Street House, E.C.2, clerk; Ethel A. Dearbens, Broad Street House, E.C. The first directors are to be appointed by the subscribers. Solicitors: C. R. Enever and Co., Broad Street House, E.C.

W. Brown & Co. (Engineers), Ltd. (12,888).—Private company. Registered in Edinburgh November 2nd. Capital, £5,000 in £1 shares. To carry on the business of mechanical and electrical engineers. The first directors are:—W. Brown, 208a, St. Vincent Street, Glasgow, engineer; Mrs. I. M. Brown, "Comfield," Muirhead, Chryston. Qualification, 200 shares. Registered office: 208a, St. Vincent Street, Glasgow.

Herd & Snowden, Ltd. (193,591).—Private company. Registered November 6th. Capital, £500 in £1 shares. To carry on the business of electrical and mechanical engineers, contractors, merchants, and manufacturers of, and dealers in electrical, magnetic, telegraphic, telephonic, and other appliances and apparatus, &c. The permanent directors are:—B. F. Snowden (managing director), 30, Rufford Road, Wallasey; W. M. Herd, 8, Mellor Road, Prenton. Qualification, £1. Registered office: D2, Exchange Buildings, Tithebarn Street, Liverpool.

Knowsley Electrical Co., Ltd. (193,527).—Private company. Registered November 2nd. Capital, £15,000 in £1 shares (7,000 preference and 8,000 ordinary). To carry on in Great Britain and elsewhere the business of electrical engineers and contractors, carriers of passengers and goods, manufacturers of, and dealers in railway, tramway, electrical, magnetic, and other apparatus, &c. The first directors are:—Major S. St. G. C. Belfield, 4, Roxburgh Mansions, Kensington Court, W.8; Capt. J. C. Connell, "Hove Dene," Poplar Avenue, Great Crosby, Liverpool; D. A. Evans, 4, Stewart Road, Waterloo, near Liverpool. Qualification, £1. Remuneration as fixed by the company. Registered office: 1, Commercial Buildings, 17, Water Street, Liverpool.

Marconi (Ireland), Ltd.—Registered as a private company on November 5th, with a nominal capital of £5,000 in £1 shares. The objects are:—To act as agents in the Free State or any part of Ireland for Marconi's Wireless Telegraph Co., Ltd., the Marconi International Marine Communication Co., Ltd., and the Relay Automatic Telephone Co., and to carry on the business of electricians, generators, &c. The subscribers (each with one share) are:—Godfrey Charles Isaacs, Lyne Grove, Virginia Water, Surrey (managing director of Marconi's Wireless Telegraph Co., Ltd.); Col. Adrian Francis H. S. Simpson, 59, Cadogan Square, London (deputy managing director, Marconi's Wireless Telegraph Co., Ltd.) The first directors are:—Senator Guglielmo Marconi, Godfrey Charles Isaacs, Col. Adrian F. H. S. Simpson, Senator James Moran, and John Fillans Barr. Secretary (*pro tem.*): A. Wright. The registered office is at Trinity Chambers, 41, Dame Street, Dublin.

Multiplex Sign Co., Ltd. (193,595).—Private company. Registered November 6th. Capital, £1,000 in £1 shares. To acquire the licence from the patentees to use and exercise the inventions in patents Nos. 188,197 and 195,192 for the United Kingdom, of Great Britain and Ireland, the Irish Free State, and the Isle of Man, and to carry on the business of electrical, mechanical, motor, and general engineers, advertising agents, &c. The first directors are:—W. E. Farmer, 33, Larkhall Rise, Clapham, S.W.4, accountant; W. H. Leijdekkers, 282, Wandsworth Road, Clapham, S.W.8, mechanical engineer; W. O. Ruddle, 14, Chip Street, Clapham, S.W.4, mechanical engineer. Acting secretary: W. E. Farmer. Registered office: 10, Kirby Street, Hatton Garden, E.C.1.

Power and Traction Finance Co. (Poland), Ltd. (193,598).—Registered on November 6th with a nominal capital of £100,000 in £1 shares. The objects are:—to seek and secure openings for the employment of capital in Poland and elsewhere, to apply for, develop, and turn to account any Act of Parliament, concession, grant, decree, right, or privilege, to purchase, underwrite, subscribe for, or otherwise acquire, hold, and deal in investments and securities of all kinds (whether British, Colonial, or foreign), to institute, carry on, finance, assist, or participate in trading, financial, industrial, manufacturing, mining, and other businesses, works, contracts, and operations, to carry on business as exporters, importers, general engineers, contractors, promoters, and financiers, &c. Specific powers are taken to acquire or construct, control, and work (*inter alia*) metal printing works, enamelling works, gas and electrical works, cables, flour and grain mills, bakeries, sawmills, paper and pulp mills, box-making and printing works, newspapers and other publications, coke ovens, foundries, transport and carrying undertakings by land, water, and air, ships, lighters, docks, wharves, breweries, distilleries, and places of amusement. The minimum cash subscription upon which the directors may proceed to allotment is 7 shares. The first directors are:—Wm. L. Hichens, 15, Buckingham Palace Gardens, S.W. (chairman of Cammell, Laird & Co., Ltd., &c.); Sir James Kemnal, Kemnal Manor, Chislehurst (managing director of Babcock & Wilcox, Ltd., &c.); Rt. Hon. Lord Meston, K.C.S.I., "Hurst," Cookham Dene, Berks. (chairman, Calcutta Electric Supply Corporation, &c.); Percy J. Pybus, C.B.E., 2, Whitehall Court, S.W. (managing director of English Electric Co., Ltd., &c.); John Sampson, C.B.E., Queen Anne's Mansions, St. James' Park, S.W. (director of Harland & Wolff, Ltd., &c.). Qualification, £100. Remuneration as fixed by the company. No notice of situation of registered office was filed at time of incorporation. (The registered office of the Power and Traction Finance Co., Ltd., registered in 1922, and having some of the same directors, is Queen's House, Kingsway, W.C.)

United Carborundum and Electrite Works (2,268f).—Particulars of Spojené Závody Pro Vyrobu Carborunda A Elektritu, Ack. Spol. (United Carborundum and Electrite Works, Ltd.) were filed on November 9th, 1923, pursuant to Section 274 of the Companies (Consolidation) Act. The capital is 15,000,000 crowns in 75,000 shares of 200 crowns each. The company was incorporated in Czecho-Slovakia to acquire from the Austrian Lunderbank at Vienna the carborundum and electrite works and manufactory at Benatek, as at January 1st, 1909, for 400,000 crowns, 250,000 being for the works and manufactory and 150,000 for the patents, marks, samples, clients, and contracts of delivery; to manufacture and deal in carborundum, electrite, and other artificial grinding instruments in rough and worked-up state, electro-chemical, incombustible and insulation products, electrodes, and other relative goods, grinding machines, &c. The British address is 72, Station Road, New Southgate, N.11, where T. E. Fowler, of the United Carborundum and Electrite Works Co., is authorised to accept service of process and notices on behalf of the company. The directors are:—V. Klement, Dresden; E. Strasser, F. Kaufmann, B. Steiner, K. Kross, and A. Hecht, all of Czecho-Slovakia; M. Kraus, M. Rotter, J. Biro, and K. O. Pollak, all of Vienna; and J. Bilinsky, Lwow, Poland.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

C. F. Elwell, Ltd.—A. C. Lucas, of Aldermary House, 60, Watling Street, E.C.4, was appointed receiver on October 24th, 1923, under powers contained in mortgage debentures dated June 3rd and 30th and October 29th, 1921.

Halifax and Bermudas Cable Co., Ltd. (28,972).—Return dated October 4th, 1923. Capital, £50,000 in £5 shares. All shares taken up. £50,000 considered as paid. Mortgages and charges, nil.

Lowth & Smith, Ltd.—T. Forster, of 28, Deansgate, Manchester, was appointed receiver and manager by Order of Court, dated July 24th, 1923. (Notice filed November 1st.)

Acme Welding Co., Ltd.—E. C. Muring, of 741-743a, Salisbury House, London Wall, E.C., ceased to act as receiver for the debenture holders on October 23rd, 1923.

Adams Brothers (Longton), Ltd.—W. H. Lawton, of 74, Church Street, Fenton, was appointed receiver on October 30th, 1923, under powers contained in debenture dated October 4th, 1923.

Yorkshire and District Electric Lamp Repairing Co., Ltd.—H. Cawood, of 68, Eyre Street, Sheffield, ceased to act as receiver or manager on November 3rd, 1923.

North Wales Power Co., Ltd.—Mortgage dated October 16th, 1923, to secure £45,000, charged on the overhead transmission line from the company's electrical system at Dolgarrog to Colwyn Bay, certain land and premises at Llandullo yu Rhos, Colwyn Bay, with transformers, switchgear, and apparatus therein. Holders: Urban District Council of Colwyn Bay and Colwyn.

Switchgear & Cowans, Ltd.—Issue on November 1st, 1923, of £1,500 debentures, part of a series.

General Cable Manufacturing Co., Ltd.—Particulars filed of £20,000 debentures authorised October 26th, 1923, charged on the company's undertaking and assets, including uncalled capital, the whole amount being now issued.

British Arc Welding Co., Ltd. (108,759).—Return dated August 9th, 1923. Capital, £50,000 in £10 shares. 1,474 shares taken up. £12,740 paid. £2,000 considered as paid. Mortgages and charges, nil.

Dixon & Corbitt and R. S. Newall & Co., Ltd. (24,228c).—Return dated September 20th, 1923. Capital, £160,000 in £1 shares. £96,150 paid. £63,850 considered as paid. Mortgages and charges, nil.

Scholey & Co., Ltd.—E. Wilkins, of 47, Mark Lane, and R. W. L. Clench, of 190, Fleet Street, E.C., were appointed receivers on November 3rd, 1923, under powers contained in debentures dated January 20th, 1922.

CITY NOTES.

Callender's Share and Investment Trust, Ltd.

The revenue for the year ended August 31st last was £23,136; working expenses, £1,120; and contribution to redemption fund £1,800; leaving a balance of £20,215. Debenture stock interest absorbs £4,372, £500 is transferred to reserve, leaving £15,343, to which is added £6,222 brought forward, giving an available total of £21,565. The directors recommended a dividend of 8 per cent., less tax, carrying forward £11,503. The debenture redemption fund stands at £24,195. The investments now held by the company amount to £303,520). Owing to advancing years and declining health, Mr. John Varley has since the last meeting ceased to be a director of the company and the directors have appointed Mr. A. W. Tait to fill the vacancy. The meeting was held yesterday.

Amazon Telegraph Co., Ltd.

The report of the directors for the year ended June 30th last shows a gross revenue of £47,400 and working expenses amounting to £27,922. After providing £2,975 for income tax, £8,997 for debenture interest, £13,876 for the sinking fund, and bringing in a balance of £173 from the previous year, there remains a deficit of £6,197. To meet this a sum of £6,500 has been transferred from the general reserve account, leaving a credit balance of £303 to be carried forward. There has been no revival of business on the Amazon during the year and the rate of exchange continued to fall, reaching, in August last, the low record of about 4¼d. per milreis. The average rate for the year was 6 5/64d., compared with 7¼d. in the previous year. Meeting: November 20th.

Montevideo Telephone Co., Ltd.

At the annual meeting on November 6th, the Chairman, Viscount St. Davids, after dealing with the accounts, referred to the agreement of 1922 with the Uruguayan Postmaster-General for the sale of the company's business in Uruguay and ratified by the shareholders at the previous meeting. He stated that owing to the changed financial conditions caused by the passing of the new law in October, 1922, compelling the company to increase wages, &c., the Uruguayan Postmaster-General had up to the present refused to complete the definite contract. The best advice had been taken in Montevideo as to the legal position of the company under the agreement, and although it was still possible that a friendly settlement might be arrived at, it might be necessary to submit the company's case to the arbitrament of the Law Courts of Uruguay. To show how unfairly the company had been treated, it should be pointed out that the minimum scale of wages for the operators forced upon the company without giving the company an opportunity of putting the Government in possession of facts, was greatly in excess of the scale demanded by those who went on strike in 1922. Under the Government Decree the company reinstated the strikers and had to pay their wages, amounting to £3,546, for the period during which they had refused to work, and during which time they had seriously damaged the company's property, necessitating an expenditure of £8,070 in carrying out the necessary repairs.

The report and accounts were adopted, and a final dividend of 3 per cent., making 5 per cent., less income tax, for the past year, was declared.

Aluminium Corporation, Ltd.

The annual meeting was held on November 8th. In presenting the report and accounts, which were reviewed in our last issue, the chairman (Mr. Kenneth M. Clark) said that 1922 had been a difficult year in all branches. Prices were low and competition was very keen, especially from Germany. From the beginning of the present year, however, the position had improved and the sales had doubled. The extension of the rolling mills had been completed and were just on the point of reaping the increased turnover. With regard to the hydro-electric works, the chairman said that all possible progress had been made with the second pipeline and power house at Dolgarrog. The new pipeline, which would have a capacity nearly three times that of the existing line was in active manufacture, and delivery of the first pipe had been promised for the present month. A larger demand from the North Wales Power Co. was anticipated in the coming year, following upon the exten-

sion of that company's transmission system. In the later stages of development the power company would draw half of its supplies from the Dolgarrog station. The Corporation had arranged to purchase a further important watershed adjacent to the Dolgarrog works, and at a subsequent extraordinary general meeting the shareholders would be asked to sanction an increase in the directors' borrowing powers to carry out extra constructional work in connection with the site. In conclusion, the chairman expressed his confidence in the ultimate success of the Corporation. The report and accounts were adopted, and the shareholders subsequently approved of an increase in the directors' borrowing powers.

Prospectuses. *County of Southland Electric Power Board.*—The prospectus was published on Friday last week offering for subscription an issue of £750,000 5 per cent. debenture bonds to bearer of £100 at 99 per cent.; the principal and interest are unconditionally guaranteed by the New Zealand Government. The principal will be repaid at par on September 15th, 1954, but the board has the right to redeem the debentures at par on or after September 15th, 1936. The present issue represents the balance of £1,500,000, which the board has power to borrow, £750,000 having been issued in August, 1921, and is to provide additional funds for the erection and equipment of the County of Southland electric power station, most of the plant for which has been, or will be purchased in this country.

Quebec Power Co.—Messrs. Aldred & Co. are offering for sale 300,000 series "A" 30-year 6 per cent. first mortgage sinking fund debenture stock at 95 per cent. The principal is due October 1st, 1953. The Shawinigan Water & Power Co. owns the majority of the combined preference and common shares. The issue was over-subscribed shortly after the opening of the list.

Stock Exchange Notices.—The undermentioned have been ordered to be officially quoted:—

American Telephone and Telegraph Co.—$17,283,900 capital stock.

Argentine Light and Power Co.—249,640 ordinary shares of £1 each, fully paid, Nos. 675,572 to 925,211; 200,000 7 per cent. preference shares of £1 each, fully paid, Nos. 665,812 to 865,811; and £301,913 6 per cent. debenture stock.

Central Electric Supply Co.—£149,700 5½ per cent. secured and guaranteed redeemable notes (registered), Nos. 2,466 and 2,467 of £100, No. 265 of £500, and Nos. 371 to 519 of £1,000.

London Electric Supply Corporation.—55,500 ordinary shares of £3 each, Nos. 111,001 to 166,500.

Dealings in the following have been specially allowed by the Committee under Rule 159:—

County of Southland Electric Power Board.—£750,000 5 per cent. debentures (to bearer), issued at 99 per cent., fully and partly paid.

Mersey Railway Co.—£669,388 new 4 per cent. first perpetual debenture stock.

Spain.—Against the consideration of 4,000 500-fr. privileged shares and 12,000 ordinary shares, the company, Los Tranvias de Murcia, has disposed of its plant and rights to the Sociedad Hispano Belga de Tranvias y Electricidad, by which transaction the whole of the network of tramways in Alicante and Murcia passes into the possession of the latter company.

The newly-built Barcelona underground railway—Ferrocarril Metropolitana de Barcelona—announces the payment of the second and third dividends of 25 per cent. on September 30th and October 31st respectively.

Electric Construction Co., Ltd.—Interim dividends at the rate of 7 per cent. per annum on the preference and at the rate of 6 per cent. per annum on the ordinary shares, both less tax.

Folkestone Electricity Supply Co., Ltd.—Dividend at the rate of 8 per cent. per annum, free of tax, on ordinary shares for the half year.

Siemens Bros. & Co., Ltd.—Dividend declared on the 10 per cent. cumulative preference shares for the year ended June 30th, last.

Barcelona Traction, Light and Power Co., Ltd.—Dividend of 1¼ per cent., less tax, on 6 per cent. first mortgage bonds.

STOCKS AND SHARES.

TUESDAY EVENING.

STOCK EXCHANGE markets sustained a severe shock by reason of the threatened General Election. This brings into play the fears of a possible Labour Government with Capital Levy and nationalisation in prospect. Upon the result of the debate in the House of Commons to-night, Tuesday, the stock markets hang with an interest so keen as to be almost painful. The suspense and the uncertainty drove prices down in all departments except those which are affected by the movements of American exchange, and a few mining markets where speculation hopes to score at the expense of investment.

Foreign capitalists who put large sums into British Government stocks at the time when the Swiss Referendum frightened the Continent, have been selling their securities and re-investing the money in American issues. This has accentuated the weakness of sterling and the strength of dollar stocks. Underground Railways income bonds are practically the only Home Railway stock which has not fallen since a week ago. The reason is, of course, that the coupons are cashable in New York at the exchange rate of the day, and it is assumed that this condition would apply to the principal also, if the bonds were to be redeemed, although on this point there seems to be a measure of doubt. Metropolitans and Districts went flat, and substantial falls took place in all the steam stocks, but there was a good rally on the announcement that the General Election is likely to take place early in December. The starting of a market in "Majorities" in the Stock Exchange, on the basis of 40 for a Conservative majority above all parties combined, served to underline the greater hopefulness which prevailed with regard to the result of the Election, and, on Tuesday evening, a better tone became discernible.

Electricity supply shares are lower on balance, though Edmundsons ordinary and preference are both 1/16 up. Falls have occurred in Charing Cross ordinary, City of London, Metropolitans and Westminsters. Bournemouth & Poole, in the provincial list, are a good market at 38s. buyers.

It is hoped that the supply companies and the L.C.C. will experience no difficulty in agreeing upon the points that are to be presented to the Electricity Commissioners as preliminary to the Parliamentary Bill, which, according to anticipation, shall extend the lives of the London companies. If the companies get their Bill, they will doubtless branch out upon important extensions that will help in the solution of the unemployment problem. Whatever demands for fresh capital these might involve will have to be considered in conjunction with the large reserves which the principal undertakings have built up for years past, and which will come in valuably for development purposes.

Brush Electric ordinary went back to 25s., and General Electric lost 9d. at 19s. 3d. London & Suburban Tractions are lower at 1s. 3d., the preference at 8s. 6d., while London United Tramway debenture drooped to 59. Para Electric first debenture at 45 is 3½ down. Singapore Electric ordinary shares gave way to 2s. Siemens preference rose sharply to 26s. on the announcement that the company is going to pay off the arrears of dividend, 2s. per share, that have accumulated since July, 1922.

Amongst the new issues, Tata Power 4½ per cent. debenture stock, guaranteed by the Imperial Government, has fallen to 3 discount upon the underwriters being left with 90 per cent. of their obligations. The 7½ per cent. second debenture, offered at 96½, was taken by the public to the extent of 17 per cent., underwriters getting 83 per cent. of the total. Tokio Electric sixes, after being lower, went better again to 88½.

Cable stocks have suffered with the rest. There are falls in Eastern Extensions, Eastern ordinary, Westerns and Globes. West India & Panama dropped to the nominal price of a shilling. Anglo-American deferred fell to 23¼, showing 15s. loss. Indo-Europeans at 31½ are £1 down. Nor have the wireless shares escaped. Marconis weakened to 2 3/16. Canadians and Radios were also lowered, but the latter recovered to 14s. The political developments have dried up the springs of enterprise as well as confidence. Bargain-hunters are said to have been in the land, but if this was the case, their traces were uncommonly difficult to cover until this (Tuesday) afternoon.

Amongst traction issues, a fall of 4 points, on sales for decreased accounts, in British Electric Traction Ordinary has reduced the price to 70½. The cheap stock was taken, however, readily enough. British Columbia Electric issues are lower, with the exception of the deferred stock, which at 96½ shows a gain of 2. Anglo-Argentine second preference at 2½ lost part of the rise of last week.

In Mexicans, no changes of importance have occurred, but Brazilian Tractions at 42 are 2 down. The same thread of gentle melancholy wanders through practically all the markets where anything approaching investment stocks are concerned. Canadian General Electric shares have spurted to 128, in consequence of the strength of the dollar as compared with the pound. Holders of the shares are in something of a quandary, not knowing whether to exchange into the new General Electric issue, whether to sell their present shares, or to keep the latter as they are. All three courses have something to recommend them, and the strength of the price is due, of course, to the exchange. If this should go against America, then the prices of the dollar stocks would come down. From the intrinsic point of view, an exchange into the General Electric stocks would seem to be a good move, though any influence adverse to the price of Canadian Generals would weigh equally against those of the General Electrics offered in exchange. From the point of view of the British holder, the best thing to do would appear to be to sell the Canadian Electrics if the price should go up three or four dollars in advance of the current quotation, for it is certain that the exchange rates between the two countries are not likely to remain abnormal for an indefinite period.

Babcock & Wilcox are dull at 2 7/32. India-rubber shares fell back to 11s. 3d. English Electric preference at 19s. 6d. are the pence harder. The whole of this section, however, is coloured by the general conditions prevailing in the Stock Exchange. Iron and steel shares are dull for similar reasons, and the rubber market, bereft of all public interest at the present time, has no other course open to it but to allow its prices to sag.

SHARE LIST OF ELECTRICAL COMPANIES.

Home Electricity Companies.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Nov. 13, 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	24	—	£5 13 0
Charing Cross Ordinary	5	9	14	12¾	— ½	5 9 10
do. do. do. 4½ Pref.	5	4½	4½	4⅞	—	5 4 4
Chelsea	1	6	10	38/-	—	5 5 3
City of London	1	14	15	2 ½	— ⅛	6 0 0
do. do. 6 % Pref. ...	1	6	6	24/-	—	5 4 4
County of London	1	8	10	2⅛	—	4 16 10
do. do. 6 % Pref. ...	1	6	6	23/3	—	5 8 3
Edmundson's Ordinary	3	Nil	7	4⅛	+ 1/16	5 0 4
do. 6 % Pref	5	12/-	6	5½	+ 1/16	5 14 3
Kensington Ordinary	5	10	12	10½	—	5 18 5
London Electric	3	4	10	5	—	5 19 9
do. do. 6 % Pref. ...	5	6	6	5½	—	5 9 1
Metropolitan	1	7	8½	1⅝	— ⅛	5 4 7
do. 4½ % Pref.	1	4½	4½	17/6	—	5 2 10
Newcastle-on-Tyne Ordinary ...	1	Nil	9½	15/-	—	5 6 8
do. 5 % Pref. ...	1	5	5	15/9	—	6 7 0
do. 7 % Pref. ...	1	7	7	23/-	—	6 1 9
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref. ...	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	Nil	—	16/3	—	Nil
do. 5 % Pref. ...	1	2½	5	¼	—	6 17 0
James' and Pall Mall ...	5	12	14½	11⅛	—	6 2 1
South London	1	7	10	1⅛	—	5 8 3
South Metropolitan Pref. ...	1	7	7	24/6	—	5 14 3
Westminster Ordinary	5	10	12	10½	— ½	5 17 3
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	1	—	7 10 0

Home Rails.

Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	2½	8½	74½	−3	4 14 0
do. District	,,	1	3	54	−2½	5 11 1
Underground Electric Ordinary	10	Nil	Nil	3½	— ½	Nil
do. do. "A" ...	1	Nil	Nil	9/-	−1/-	Nil
do. do. Income	Bonds	4	5	100	+1	*5 0 0

Telegraphs and Telephones.

Anglo-Am. Tel. Pref.	Stock	6	6	103	—	5 16 6
do. Def.	,,	1½	34/6	23½	— ¾	6 9 0
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7½	—	9 13 2
Eastern Extension	10	10	10	17	— ½	5 17 8
Eastern Tel. Ord.	Stock	10	10	170½	−2	5 17 4
Globe Tel. and T. Ord.	10	10	10	17½	— ½	5 14 3
do. do. Pref. ...	10	6	6	11½	—	5 7 7
Great Northern Tel.	10	24	22	28	—	7 17 2
Indo-European	25	10	7	31½	−1	*5 11 1
Marconi	1	25	15	2⅛	— 1/16	6 17 0
Oriental Telephone Ord. ...	1	12	12	1⅝	—	*6 8 0
United R. Plate Tel.	5	8	8	6¾	—	*5 16 4
West India and Panama ...	10	Nil	Nil	1/-	−6d.	Nil
Western Telegraph	10	10	10	17	— ¼	*5 17 8

Home and Foreign Trams, &c.

Anglo-Arg. Trams. First Pref.	5	5½	12½	21¾	—	9 7 2
do. do. 2nd Pref.	5	Nil	5½	22	— ½	10 9 6
do. do. 5% Deb.	Stock	5	5	70½	—	6 10 9
British Electric Traction Ord.	,,	4½	5	70½	−4	7 1 10
do. do. 6 % Pref.	,,	6	6	101½	—	5 18 8
Brazil Tractions	100	Nil	4	42	−2	9 10 6
Brit. Columbia Elec. Rly. Pos.	Stock	5	5	84½	−1	5 18 4
do. do. Preferred	,,	5	96/-	83½	−1	*5 15 1
do. do. Deferred	,,	8	127/-	95½	+1	*6 9 9
do. do. Deb. ...	,,	4½	4½	78½	—	5 8 3
Lond. & Sub. Trac. 5 % Pref.	1	5⅛	5	8/6	−6d.	11 15 4
London United Tram. Deb. ...	Stock	4	4	59	−1	6 13 4
Mexico Trams. 5 % Bonds ...	—	Nil	Nil	76½	—	6 10 9
do. 6 % Bonds ...	—	Nil	Nil	83½	−1	Nil
Mexican Light Common ...	100	Nil	Nil	24	—	Nil
do. Pref.	100	Nil	Nil	52½	—	Nil
do. 1st Bonds ...	—	Nil	5	68½	—	7 6 0

Manufacturing Companies.

Babcock & Wilcox	1	15	20	2⅝xd	— 1/16	*4 10 1
British Aluminium Ord. ...	1	10	5	18/3	—	5 9 8
British Insulated Ord.	1	15	15	24	—	6 0 0
Callenders	1	15	15	49/6	—	6 1 2
do. 6½ Pref.	1	6½	6½	26/-	—	5 4 0
Crompton Ord.	1	10	5	½	—	10 0 0
Edison-Swan	1	10	Nil	4/6	—	Nil
do. do. 5% Deb.	Stock	5	5	65	—	7 13 10
Electric Construction	1	10	10	29/6	—	6 15 7
English Electric	1	8	5	18/3	—	5 9 7
do. do. Pref.	1	6	6	19/6	+6d.	6 3 1
Gen. Elec. Pref.	1	6½	6½	23/-	—	5 13 3
do. Ord.	1	10	5	19/3	−9d.	5 4 0
Henley	1	15	15	2½	—	6 0 0
do. 4½ Pref.	5	4½	4½	4¼	—	5 2 10
India-Rubber	1	10	—	11/3	−6d.	—
Met.-Vickers Pref.	2	8	8	2⅛	+ 1/16	5 19 0
Siemens Ord.	1	10	10	15/-	—	Nil
Telegraph Con.	12	20	20	25	—	*5 0 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS FOR CHEMICALS AND METALS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general and they may vary according to quantities and other circumstances.

CHEMICALS, &c.	Price Nov. 14.	Fortnight's Inc. or dec.
a Acid, Oxalic ... ... per lb.	5½d.	...
a Ammoniac, Sal ... ... per ton	£60	...
a Ammonia, Muriate (large crystal) ,,	£52	...
a Bisulphide of Carbon ... ... ,,	...	...
a Borax ... ... ,,	£15	...
a Copper Sulphate ... ... ,,	£25 10s.	...
a Potash, Chlorate ... ... per lb.	4d. to 4½d.	...
a ,, Perchlorate ... ... ,,	4d.	...
a Shellac ... ... per cwt.	£15 15s.	15s. dec.
a Sulphur, Sublimed Flowers ... ,,	£7 15s.	...
a ,, Roll ... ... ,,	£7 15s.	...
a Soda, Chlorate ... ... per lb.	3d.	...
a ,, Crystals ... ... per ton	£5 to £5 5s.	...
a Sodium Bichromate, casks ... per lb.	4½d.	...
METALS, &c.		
b Aluminium, Ingots ... ... per ton	£115 to £120	...
b ,, Wire ... ... per lb.	1/9 to 2/6*	...
b ,, Sheet ... ... ,,	1/6 to 2/-	...
p Babbitt's Metal and Anti-friction Metal—		
Grade I ... ... per ton net	£203	£10 inc.
Grade II ... ... ,, ,,	£146	£6 inc.
Grade III... ... ... ,, ,,	£82	£3 inc.
c Brass (rolled metal 2" to 12" basis) per lb.	9¼d.	¼d. inc.
c ,, Tubes (solid drawn) ... ,,	1/0 to 1/0½d.	¼d. inc.
c ,, Wire, basis ... ... ,,	10½d.	¼d. inc.
c Copper Tubes (solid drawn) ... ,,	1/1½d.	¼d. inc.
c ,, Bars (best selected) ... per ton	£95	£3 inc.
c ,, Sheet ... ... ,,	£95	£3 inc.
c ,, Rod ... ... ,,	£95	£3 inc.
d ,, (Electrolytic) Bars ... ,,	£87	70/- inc.
d ,, ,, Sheets ... ,,	£145 10s.	...
d ,, ,, Wire Rods ,,	£77	70/- inc.
d ,, ,, H.C. Wire per lb.	9½d.	¼d. inc.
f Ebonite Rod ... ... ,,	8/6	...
f ,, Sheet ... ... ,,	8/-	...
n German Silver Wire ... ... ,,	2/3	...
h Gutta-percha, fine ... ... ,,	6/6	...
h India-rubber, Para fine ... ... ,,	1/0½	¼d. inc.
i Iron Pig (Cleveland Warrants) ... per ton	£5 2s. to £5 2s. 6d.	...
i ,, Wire, galv. No. 8, P.O. qual. ,,	£25	15/- inc.
g Lead, English Pig ... ... ,,	£32 15s.	£2 dec.
g Mercury ... ... per bot.	£9 15s. to £9 17s. 6d.	2/6 to 5/- inc.
e Mica (in original cases) small ... per lb.	3d. to 3/-	...
e ,, ,, medium... ,,	4/- to 8/-	...
e ,, ,, large ... ,,	10/- to 20/- & up.	...
p Phosphor Bronze, plain castings ,,	1/3	...
p ,, drawn bars and rods ,,	1/2½	...
p ,, rolled strip & sheet ,,	1/2½	...
p ,, wire ... ... ,,	1/3½	¼d. inc.
o Platinum ... ... per oz.	£35	...
d Silicium Bronze Wire ... ... per lb.	1/0½	...
r Steel, Magnet, in bars ... ... ,,	10d.	...
n Tin, Block (English) ... ... per ton	£220 to £220 15s.	£12 to £12 5s. inc.
n ,, Wire, Nos. 1 to 16 ... ... per lb.	3/-	...

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Electric Lighting of French Trains.—As may perhaps be remembered, the French Minister of Public Works, as far far back as October, 1921, issued a circular to the railway companies requiring them to discontinue the use of gas for the lighting of passenger trains. The instructions given by the Minister were that the use of gas was to be abandoned by January 1st, 1923, in the case of express trains, a year later in the case of trains performing suburban services in the vicinity of large towns, and by January 1st, 1925, in the case of all other passenger trains. As a result of an inquiry made by the railway supervising authorities it has been ascertained that all the coaches employed in the express passenger service will shortly be lighted by electricity. The transformation is practically complete on the Northern and the State railways; only some luggage vans remain to be electrically equipped on the Paris, Lyons, and Mediterranean Railway, the Eastern Railway and the Alsace and Lorraine Railways, while the Southern Railway is some months behind in the matter. In the case of the suburban and other passenger trains it is expected that the time limits will be adhered to, especially as the Ministry of Public Works has not permitted any deviation from the original instructions. The total number of passenger coaches on all the railways combined wherein gas still has to be replaced is about 22,000, or about one-half of the number of passenger coaches in service. But as the companies have obtained exemption from the obligation to substitute electric light for gas in the case of the coaches of old types, which are finally to disappear in ten years' time, the number of coaches yet to be electrically lighted in reality is only 10,000. Pending their discontinuance for passenger service these old coaches are to be lighted by means of oil. In general it is stated that the railways have made a strong effort to comply with the instructions which were officially given over two years ago.

MICA AND MICANITE INSULATION.

The Difficulties Besetting the Choice of Quality best suited to the Work.

By ARCHIBALD A. C. DICKSON.

It is generally admitted by the leading electrical engineers that future economy in the construction of electrical machinery lies in the insulation, a view which I readily endorse.

Mica is admitted to be the best solid insulating material on the market, but, unfortunately, mica, irrespective of quality, is what the majority of buyers seek, especially if they are offered a cheap mica which quite satisfies them, owing to their unenlightenment. They think that they are saving money for their employers, when, in reality, as will be shown further on, they may actually not only be wasting money, but also may inadvertently be getting their firm a bad name in the market—a name which spells "unreliability." It should never be forgotten that it is of paramount importance to the manufacturer of electrical machinery that the correct use of insulating materials of high quality not only leads to the greatest economy in construction, but also determines the "reliability" of the machine, which is of far greater value than construction to the actual users of electrical machinery.

If a manufacturer can say: "Here is a machine so insulated that it will last for years"—against the man who says: "Here is a cheap machine, it looks the same as the other, but I cannot guarantee it for any length of time, as I cannot vouch for the insulation"—whose machine will be bought by the intelligent contractor, buyer, or user?

I have known firms naively to buy and use "biotite" (a ferro-magnesian mica with a very high percentage of iron in its chemical composition, which is deleterious to insulation) for commutator segments (mineralogically it belongs to the phlogopite, or so-called "amber mica" family, and honestly could, by an ignorant person, be offered under the general trade name of amber mica, as suitable to the work) because it was cheap and they really thought that they were striking quite a good bargain, especially as it seemed, in thin films, brown, and looked the same as amber to the non-technical buyer. In my experience I have seen the motors of some reputable large manufacturers condemned for this one reason alone—poor insulation; hence this article to give the electrical industry in general a rough idea of what it actually ought to look into when considering the purchase and use of mica and mica goods as insulators for machines.

I will first consider the hardness of mica (when I speak of mica I mean *natural* mica, which is a matter of importance, as some smaller firms use the term "mica" indiscriminately for both mica and micanite) for commutator work. The hardness or softness is tested on the wearing or cut edge of the mica, and has nothing whatever to do with the firmness or rigidity of the plate or segment itself.

My own experience (covering over 18 years) leads me to place the present commercial micas of which I have knowledge as follows:—

1. Soft, fairly clear, brown amber and Madras soft brown and soft green.
2. The physically purer opaque ambers. Some opaque amber micas are unreliable owing to the minute spherical air bubbles in their inner laminæ. These bubbles easily break and weaken the insulation.
3. White India mica and some electric ruby spotted mica and some opaque ambers.
4. Some varieties of Calcutta, Madras, and other countries, spotted and matted micas, and some opaque ambers.
5. Some varieties of ruby, brown, green, and rum.
6. Hard ruby, green, brown, and rum.

There are so many divisions and subdivisions of these different qualities that it would be futile to attempt to definitely place any generic quality to a fixed standard hardness, hence the injunction to leave the selection to the technical specialist.

Physical Properties.—From this point of view it is difficult to judge mica from its generic name as a Muscovite or, more particularly, a Calcutta ruby may be clear, hard, and flawless, or clear and soft with interlaminar defects. Of course, the trouble is less accentuated in Calcutta assortments, as defective clear mica is usually put in a lower grade or class, *i.e.*, the clear soft ruby would not be packed with the clear hard ruby, and would also naturally be cheaper. Clear mica is generally a misnomer. With the amber micas the conditions are quite different—good and bad are packed together, so that the buyer and user have to chance what they get. Madras mica, which is a Muscovite, is like the Calcutta mica classified as a guide to the buyer, but, unfortunately, the classification is not so good as that of the Calcutta mica. An important fact worth recording is that new fields, owing to ignorance, send their mica to London in the crudest and most unreliable condition imaginable.

Colour is often a guide in amber mica, as it frequently means deleterious variations in chemical composition which may make all the difference between good and bad insulating properties. Some Muscovite micas suffer in another way, *e.g.*, a hazy smoky look may mean only water stains, or numerous spherical air bubbles, or even fine rock punctures through some of the internal films, which are hard to discern without testing. The latter failing is decidedly detrimental to insulation. Even slight variations in colour often affect the elasticity, hardness, and dielectric properties of a mica. I might instance the black-looking ambers, which contain 16 per cent. iron, against the lighter ambers, which only contain from 1 to 2 per cent. iron.

Thermal Properties.—Ordinarily micas can be safely heated, without fear of any change, to 400 deg. C., and some even up to 800 deg. C., but, as stated above, the different colours and classes of the magnesia or amber family, and the potassium or Muscovite family, will stand different temperatures, sometimes with a variation of 200 deg. C. Another important factor is that some amber micas on continued heating, if brought in contact with certain acids (among others sulphuric acid may be mentioned, as it is largely used in the electrical trade), are completely disintegrated, but this is not so where the Muscovite micas are concerned, except where combined rare acids not generally used by the electrical industry are in evidence.

Almost each purpose requires some definite properties or qualities which may be wholly possessed by the initially more expensive mica and only partly by the initially less expensive mica. It will be apparent that by straightaway using the mica recommended by one who knows the dielectric strength, electrical and thermal resistances, chemical compositions, and physical properties of mica as best suited to the purpose, even though the initial price may be a few pence higher than the cheaper, poorer, job-line substitute mica, the British electrical industry will benefit a thousandfold, as the word "reliability" will thenceforth be stamped on those machines in contradistinction to the others using the cheaper, poorer, unreliable substitute mica.

A good dielectric mica may have a poor thermal resistance, and a poor dielectric mica may have a high thermal resistance, and yet, perhaps, both may be good

insulators each in its own field, and may not be able to take the place of each other.

A few remarks here about electric spotted mica, before disposing of the natural mica problem, may be apposite. There are several varieties of so-called black spotted mica. Some are hard, some soft, others matted or cross-marked, and popularly called by miners hieroglyphic mica. The proper electric spotted mica is a ruby or green, fairly hard mica, with spots or dots and certain other markings over part, or the whole, of the plate—sometimes so dense that the whole mica looks black in thick plates. Still, it is quite safe to use these for ordinary electrical insulation. But the cross-marked (a lot of South African mica is of this class) are highly charged iron interlaminated micas which are decidedly unsafe to use, except where very low voltages are concerned. Red and yellow, or yellow-brown stained, or blotched mica, the so-called mud-stained mica, is also iron-charged in the forms of hematite and limonite respectively, and may be placed in the same category as the black cross-marked micas.

Micanite and mica goods are as dependent on the quality of the adhesive used as they are on the quality of mica splittings; in fact, in some cases more so, *e.g.*, a cheap moulding micanite can be made at the expense of the quality by heavy adulteration of the shellac with a cheap resin, which latter is so triturable that it powders, thereby loosening the films it holds, and allowing them to fall away under moderate strains, whereas a purer shellac adhesive will stand very much greater strains. Therefore, not considering the other advantages, we find that the latter quality—the purer shellac adhesive micanite—even though apparently more expensive, will prove, in practice, to be the cheaper, as it will have a much longer life and be reliable. One might almost say that the frenzied competition, reducing price apparently irrespective of costs, but really by adulteration of the adhesive and lowering of quality, is responsible not only for demoralising the trade, but also for greatly injuring the future of the electrical industry in general.

It is a short-sighted, pernicious policy that should be looked into by the technical heads of the insulating departments of the various manufacturing electrical engineers if the reliability of the British-made electrical machinery is to be properly established and stabilised. It is quite possible to detect the difference in quality between the purer shellac adhesive micanite and the inferior adulterated adhesive micanite by inspection of small sample pieces of both qualities.

Commutator micanite, if properly made and if it really contains the specified limits of adhesive—minimum 2 per cent. and maximum 5 per cent.—is a decidedly white micanite, and if, as is supposed to be usual, a uniformly split thin mica splitting be used in the manufacture, there is no need to go to the extra expense of milling the micanite, as this only sends the price up by about 15 to 25 per cent., according to the process of the maker. Here is a good field for improvement and one worthy the notice of the larger users.

Finally, my readers must bear in mind that there are many varieties of natural mica sold under the same generic name, and there are many varieties of the same generally named built-up mica goods, micanite, &c., which are difficult for the buyer to differentiate. Therefore, it is up to the insulation departments of each and every firm of manufacturing electrical engineers to keep their buyers well informed of their testing results of the various samples sent to them, as a guide to the buyer, in order that the reliability and the looked-for economy in the future construction of electrical machinery may be assumed.

MARKET LIGHTING.

The accompanying illustration shows the general arrangement for supplying the stallholders in the centre of the Market Square, St. Albans, with electric light on Saturday evenings from the mains of the North Metropolitan Electric Power Supply Co.

An armoured service cable is laid to a cast-iron service box, which can be seen fixed to the lamp-post in the centre of the square, containing main fuses, circuit fuses, and connecting plugs, of which there are four. Ground sockets are fixed permanently in suitable positions and allow of wooden poles being easily erected and removed.

The poles carry the overhead cables, which are C.T.S. The service lines to the various stalls are also C.T.S.; they are permanently jointed to the main cables and have a lamp-holder attached to the other end. By means of lamp-holder adapters, a number of lights can be given to any one stall.

St. Albans: Market Lighting.

The whole of the poles, cables, service lines, and lamps remain the property of the company, are placed in position each Saturday morning, and are removed at the termination of the market the same evening.

Two sizes of lamps have been standardised, 60- and 100-watt gasfilled, the schedule of charges being as follows:—

	60-watt.	100-watt.
1 light per night ...	2s. 0d.	2s. 4d.
2 lights per night ...	2s. 6d.	3s. 2d.
3 lights per night ...	3s. 0d.	4s. 0d.
4 lights per night ...	3s. 6d.	4s. 10d.

Payment is collected each Saturday morning before the lamps are put into position, the stallholders being given the option of one or more lamps according to requirements. No stallholder is under any obligation for payment should he not require a supply.

A man is available to deal with any failure which may occur during the hours the stalls are lighted. The scheme has met with every success, practically all stallholders taking a supply.

We are indebted to Mr. G. C. Chamberlain, resident engineer, for these particulars and the photograph here reproduced. The electrical features in the view have been purposely emphasised in the process of reproduction.

ERSKINE HEAP SWITCHGEAR.

Messrs. Erskine Heap & Co., Ltd., of Manchester, who for many years have specialised in a.c. switchgear, have put on the market a line of a.c., oil-immersed control gear incorporating some novel features. It is claimed that this switchgear is characterised by simplicity of design, combined with robustness of manufacture. All safety devices necessary for giving ample protection to the motor have been embodied, and every effort has been made to make the starter "fool-proof" in operation, but the use of all unnecessary "gadgets" has been avoided, thus reducing to a minimum those parts most likely to cause trouble.

The starters are of the vertical drum type, as illustrated in fig. 1, which shows an auto-transformer starter with tank removed, fitted with three overload trips and no-voltage release; they combine the functions of a separate circuit-breaker and

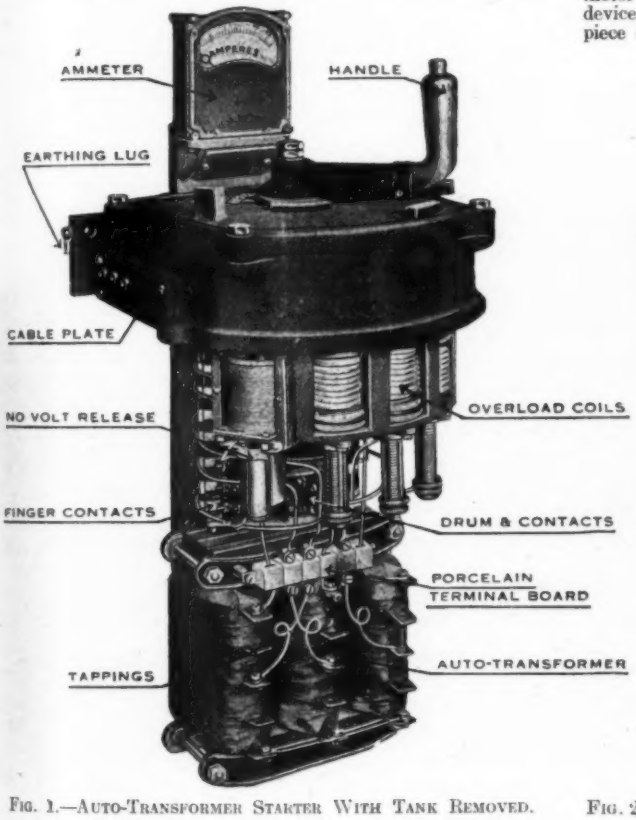


Fig. 1.—Auto-Transformer Starter With Tank Removed.

starter in one self-contained unit, the drum with its contact fingers, the triple coils and transformers being all oil-immersed and contained in the one tank. This arrangement makes a compact unit, and beside giving thorough protection to all the working parts, facilitates inspection, for by the simple operation of removing the tank, all parts can be examined, and are easily accessible for renewal or repairs.

The internal connections of the starter are so arranged that the overload trips may be either cut out of circuit in the starting position or, if preferred, they may be left in circuit in the starting as well as in the running position. In the latter case it is advisable to fit a dash-pot time-limit device to them to prevent the breaker being tripped out by the rush of current at starting. All the starters are fitted as a standard with a "free" handle, so that the starter cannot be held closed should an overload occur, but trips independently of the handle. A stop is attached to the handle lever so that when the starter is pushed into the starting position it is checked there, and the operator cannot inadvertently overrun the position. When he wishes to move into the running position he can free the handle lever by depressing the button at the top of the handle. This enables him to pass into the running position. The operator cannot inadvertently leave the handle in the starting position, as, owing to the controlling spring, unless it is held there, it will return to the "off" position. Once, however, the handle has reached the running position, it may be left there.

A useful isolating arrangement has been fitted to these starters; this is shown in fig. 2, and consists of an isolating plug which is withdrawn when the tank is lowered. This means that when the tank is removed for inspection purposes, all contacts and connections are automatically made dead, a separate switch for isolating the starter being thus unnecessary. This method of isolating has the additional safeguard of preventing the current being applied to the starter until the tank is in position, and thus avoiding the possibility of current being broken by the starter when the tank is removed. It is not possible to break circuit at the plug contacts, as, when the tank is lowered, in the first part of its travel, it mechanically operates the tripping gear, causing the starter to return to the "off" position.

The rotor starter is designed on the same general lines as the auto-transformer starter, the resistances being mounted in the bottom of the tank, and the stator and rotor contacts being mounted on the same drum; it thus combines in one self-contained unit the double function of a separate stator switch and rotor starter, with a perfect mechanical interlock between the two.

To ensure that an unskilled operator shall not start up a motor too quickly, these starters are fitted with a slow-motion device, which consists of a "gate" arrangement. A stop piece on the underside of the starter handle engages succes-

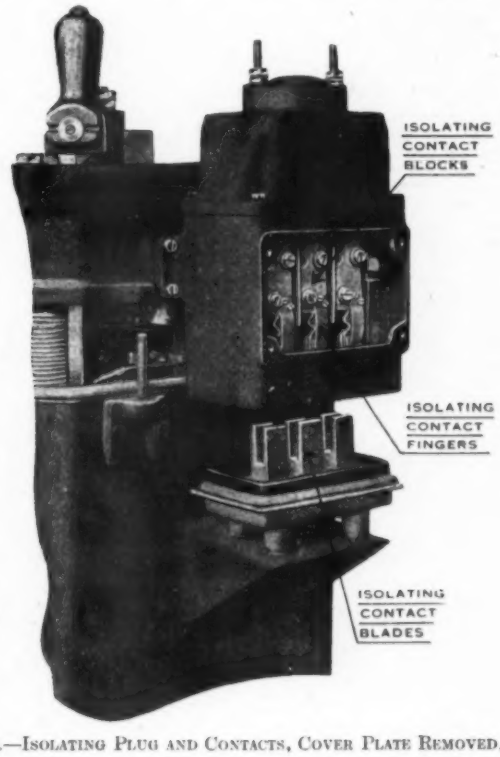


Fig. 2.—Isolating Plug and Contacts, Cover Plate Removed.

sively with a number of projection pieces cast on the top of the starter lid, and is freed from each in turn by an inward or outward movement of the handle, which has a certain amount of play in a radial direction on the crank arm. The first movement of the handle closes the stator contacts, and each successive movement cuts out a section of resistance until the running position is reached, and the motor is switched direct on to the line.

Starters of this design are made up to a capacity of 150 amperes for star-delta or auto-transformer starters, and 150 stator amperes and 300 rotor amperes for rotor starters. Above these capacities a separate oil switch and non-automatic starter are used.

Electric Lighting on Motor-cycles.—If there is one direction in which the average motor-cycle lags sadly behind the car (says *Motor Cycling*) it is in lighting equipment. No car manufacturer would think of listing even the cheapest type of car without including in the specification a satisfactory electric lighting system, yet the great majority of motor-cycles are still sold without any lamps at all. It is true that one or two factories have standardised electric lighting on all models, but the example has not been widely followed. Finality will not be reached until every motor-cycle, like every car, is fitted with an electric lighting set of proved reliability, capable of giving sufficient driving light under all conditions.

Automobile Lighting.—For the fifth year in succession electrical equipment made by Messrs. C. A. Vandervell & Co., Ltd., is fitted, it is claimed, to the largest number of cars shown at the Olympia Motor-car Show, and in view of the numerous foreign exhibitors this speaks highly for the Acton firm.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Mersey and North Wales (Liverpool) Centre—Chairman's Address.

Mr. E. M. Hollingsworth, chairman, delivered his inaugural address at the above-named Centre of the Institution, on November 5th, at the Liverpool University. By permission of Prof. E. W. Marchant, D.Sc., M.I.E.E., the laboratories will be open during the evening on meeting dates throughout the session, when demonstrations in radio-reception will be given in the library. An abstract of the address follows:—

It is my intention to survey the recent advances made in power station practice.

Regarding the movement in the direction of extremely high steam pressures and temperatures, it has to be admitted that our knowledge of the properties of metals to withstand such conditions is still very imperfect. Will the gain in thermal efficiency be obtained only at the sacrifice of reliability?

In recent practice in the design of stations, great importance is attached to daylight illumination and the satisfactory ventilation of the buildings, for these refinements have considerable bearing on the maintenance of maximum operating efficiency.

The mechanical handling and conveying of coal by means of pneumatic plant offers the advantage of greater flexibility and speed, but at considerably higher operating cost, as compared with the methods in more general use.

The great advance in size and output of the boilers now installed is due, not to any probable gain in efficiency, as compared with smaller plant, but primarily to the necessity of reducing the size of the boiler house to within reasonable measure of the turbine room. Even with the large boilers now being installed, there is still a disparity in the ratio of approximately 1.75 to 1. Boilers of 16,000 sq. ft. heating surface and 120,000 lb. actual evaporation per hour are in operation in this country. In America, boilers of 200,000 lb. evaporation per hour are becoming quite common.

The largest British and American stations recently completed, or approaching completion, show that the adoption of higher pressures is by no means general. Of twelve British stations, one is working with a steam pressure of 475 lb. per sq. in., two have adopted 375 lb., two 320 lb., four 250 lb., and three 200 lb. per sq. in. The total steam temperatures range from 550 to 750 deg. F.

Of 12 American stations, two have decided upon a pressure of 550 lb. per sq. in., three have adopted 400 lb., two 375 lb., one 350 lb., and five 300 lb. per sq. in. The steam temperatures range from 625 to 725 deg. F. In two of the American stations some experimental plant at a pressure of 1,200 lb. per sq. in. is being installed to work in conjunction with the main plant.

So far as the mechanism for feeding and distribution of coal, and for the ejection of ashes, is concerned, it is difficult to see where any further great improvement can be made. From the combustion and furnace efficiency points of view, however, there is still room for more satisfactory results, and the stoker is yet to be designed that will efficiently deal with all grades of coal, particularly the low calorific value slacks which many British stations are compelled to use. Brickwork arches are a source of weakness, and with modern high-capacity boilers, whatever method of firing is adopted, the upkeep of the brickwork setting is troublesome. Probably future furnace design will be in the direction of dispensing with brickwork and surrounding the chamber with water-cooled surfaces. The removal and disposal of the ash and clinker has all along been somewhat of a problem. Suction ash plant still finds some favour, notwithstanding its heavy maintenance and operating costs, as compared with the simpler systems. It, however, offers the advantages of cleanliness and flexibility for a congested layout.

Automatic regulation of the feed water to the boiler is very desirable, and there are reliable regulators on the market. The higher the efficiency of the plant installed, the greater is the necessity for scientific supervision and control, and for the provision of a complete equipment of instruments.

In this country the size of turbo-alternator sets has so far been limited to 30,000 kW at 1,500 r.p.m., and to 20,000 kW at 3,000 r.p.m., the latter size will be the most economical yet produced, taking into consideration both capital cost per kilowatt and performance, for it is anticipated that its efficiency will be little lower than that of a set of the same capacity operating at 1,500 r.p.m. It must be admitted, however, that the lower-speed set has the advantage of reduced stresses and, therefore, greater reliability. In all probability the tendency will be in the direction of the sub-division of the turbine into two cylinders, high pressure and low pressure, on one shaft. Such an arrangement means some increase in efficiency and simplifies the system of reheating the steam before it passes to the low-pressure portion of the turbine. The higher the steam pressure, the greater is the necessity to adopt the reheating cycle.

Regarding corrosion, it is considered that the closed feed-water circuit and degassing system will prove beneficial. Further, most stations are now taking the precaution of preventing steam leakage into the turbine when it is standing idle and it is also usually the practice to leave the air pump in operation for some time after the turbine has been shut down.

Investigation of the relation of temperature to the life of the generator insulating medium has given more confidence, and resulted in a greater tendency to accept machines designed to work at higher temperature limits, although there would seem to be need for caution with regard to some of the high temperatures proposed.

It is now possible to obtain surface condensing plant which will produce a vacuum so close to the theoretical limit that only in detail, and possibly in reduced operating power, can any further developments be looked for. It is now the practice to connect the condenser direct to the turbine, that is, without an expansion piece, and to obtain the necessary flexibility by mounting the former on springs. When working with higher temperatures there is all the more necessity to provide for free expansion in the design and layout of the turbine and condensing plant. The usual method of controlling the supply of circulating water is by throttling on the delivery side of the pump, but the variable-speed motor, or the two-pump arrangement give advantage in the direction of economical operation.

Beyond adopting efficient screening plant and taking steps to prevent air leakage in delivery pipes, to limit aeration, it is not practicable to improve the condition of the circuiting water with the object of preventing corrosion of the tubes and other parts of condensing plant. Although a great deal of investigation and research work has been carried out, it cannot be said that we have travelled far towards a solution of this problem. Corrosion has been reduced in a number of cases by the amplication of electrolytic methods, but the treatment found satisfactory in one case is of little use in another; there are many variables, and time is the most important factor. The power required, and therefore the cost of obtaining the highest vacuum possible under given conditions, is a serious matter; in fractional-load stations it may be more economical to work with a somewhat lower vacuum, but in a base-load station the highest vacuum will mean the greatest economy.

Respecting condensing auxiliaries, probably the most popular extractor is the multi-ejector which, compared with other methods, offers the advantage of simplicity and economy of working when the waste heat can be efficiently included in the station heat balance. It is becoming the practice to duplicate the condensate and other pumps, usually having each set from 75 per cent. to full capacity. Practice also tends more and more towards the use of motor-driven auxiliaries. The electric drive has the advantages of lower first cost, more adaptability, and also greater economy; that is, when the waste heat from the steam drive cannot be fully utilised. Further, it may be considered equally reliable, particularly where motors are duplicated on the same drive and are supplied with energy from different sources.

As regards auxiliary supplies "house" turbo-generating sets are adopted in many stations. In other cases, one set is in use in parallel with the main bus bars through transformers and so interconnected that, in case of trouble on the main system, the auxiliary supply is automatically thrown on to the house sets. This is a move in the direction of improved efficiency, but possibly at the sacrifice of some reliability. To obtain still greater efficiency, however, the tendency is to dispense with house sets, and to take the supply from an auxiliary machine on the main generator shaft, with a stand-by supply through transformers, or converting plant.

Whilst the majority of stations in this country have installed switchgear of the type relying for security against short circuits by wide spacing of the live parts in air, and enclosed in stoneware or brickwork cubicles, the enclosed compound-filled type of gear is finding considerable favour. This type has certainly amongst its advantages that of robustness and reduced space required, but the parts are not quite so accessible as with cellular gear. There are many stations in America, and a number on the Continent, wherein the switchgear layout does not include cubicles and the only safeguards are rails placed round each circuit unit. In this country we certainly go to the extreme limit as regards special protection to minimise danger to life and to secure continuity of supply. Of course, the Government regulations in this country are much more stringent than those in force in other countries.

The above remarks also apply to the automatic isolation of faults in generators, transformers, and feeders, for British practice makes full use of the various protective systems available. No doubt such practice will continue until some revolution in plant design dispenses with their necessity. In other countries practice leans towards the opposite extreme and, in the majority of cases, the protective devices are of the simplest kind. Several of the American undertakings are taking steps to ensure greater protection by such means, but owing to

the size and complications of the systems the problem offers many difficulties.

Power station efficiencies for last year, recently published by the Electricity Commissioners, are somewhat disappointing in that the maximum thermal efficiency does not reach 18 per cent., and shows very little improvement on the maximum of the previous year. The case for higher steam pressures is not helped by the fact that some of the best results are in stations working with comparatively low pressures and under no better load factor conditions. Thermal efficiency is not the only factor in economical generation; capital and maintenance costs are also of importance, but the returns certainly emphasise the necessity for making every effort to obtained increased thermal efficiency as a net advantage.

From the figures given by the Commissioners there are stations at present generating a kilowatt-hour for 18,000 B.th.u. of heat, and in America there are stations approaching completion where figures of 14,000 and even 12,000 B.th.u. (equal to overall efficiencies of 24 and 28½ per cent. respectively) are mentioned, but to obtain such a result some of the plant will be required to operate at a steam pressure of probably not less than 1,200 lb. Such results will not be obtained by increasing the pressure and temperature ranges only, but also by reducing existing heat losses and by improvements in other directions. For instance, the operating efficiency of large present-day boiler plant, including a superheater and stoker-fired furnace, may be taken as at least 80 per cent. with coal of approximately 10,500 B.th.u. It is maintained that an increase of 2 per cent. can be obtained by burning pulverised coal under similar working conditions.

Turbo-generator steam consumption has been reduced to 10 lb. per kilowatt-hour, including auxiliaries, and an overall efficiency value of 77 per cent. can be obtained. Pending improvements in turbine construction, it is anticipated, will lead to an increased efficiency ratio.

Things are moving rapidly in these times and we may realise sooner than is expected the possibility of producing one kilowatt-hour for, say, one and a quarter pounds of inferior coal.

North-Western Centre: Chairman's Address.

Mr. G. A. Juhlin, chairman of the above Centre of the Institution, delivered his inaugural address at Manchester on November 6th. He said, *inter alia*, that in present difficult times he was not sure that they were working along the best lines. In order to obtain the best results from an industry it was essential that the user and the maker of plant should be in close contact. There was undoubtedly need for co-operation between the Institution and the engineers responsible for electrical installations in collieries. It seemed a great pity that a separate organisation should cater for the mining electrical engineers, and some effort should be made to obtain co-operation. Marine work bristled with special requirements, and was a comparatively new field as far as electricity was concerned. In other directions there seemed to be room for expansion. The manufacturing side of their industry was not strongly represented in the Institution, and he was convinced that that fact was retarding progress very considerably. Manufacturing methods were so closely related to designing that they could hardly be separated if progress was to be made. While designers interchanged views through the medium of their meetings there was a great deal of reticence regarding shop matters. This was very apparent when comparing the conditions in this respect in the U.S.A. with those in this country. A great deal could be done by encouraging papers dealing with manufacturing problems and shop organisation; it would bring out the fact that the manufacturing side offered a promising field for the technically-trained engineer, which did not seem to be fully appreciated at present. The statement that they could only solve industrial problems by increasing output had become hackneyed. It was appreciated, however, that this could not be obtained by the efforts of the workmen alone. It could only be done by careful organisation and the elimination of useless effort, which surely was the work of the engineer, whether engaged in designing or manufacturing. It was because this fact had been recognised in the United States that they had progressed so rapidly. A prominent one of the many factors conducive to the rapid strides of electrical engineering in America was that utility was the keynote of all work. Super-excellence was not looked for or considered worth paying for.

British manufacturers were in a position to meet the demands in respect of size of generators. Sets capable of developing 40,000 kVA at 1,500 r.p.m. and 18,750 kVA at 3,000 r.p.m. were in commercial operation, and 25,000 kVA sets at 3,000 r.p.m. were under construction. The total electrical breakdowns of turbo-generating plant reported by two of the large companies in 1921 was less than 1 per cent., and recent figures showed that this percentage was decreasing, a splendid result considering that pioneer work was being undertaken all the time. A recent report on the operation of the 50,000-kVA sets installed in Germany during the war led to doubt whether such large sets were justified. Should the demand for such large sets arise in this country, however, there was no doubt it would be met. The output of turbo generating plant in the U.S.A. was approximately 2,000,000 kW. in addition to which there was a large amount of hydro-electric plant installed. The total kilowatt capacity of plant ordered in this country during the last twelve years was:—

Year.	Total kW.	Year.	Total kW.
1912	162,000	1918	344,000
1913	271,000	1919	500,000
1914	269,000	1920	736,000
1915	333,000	1921	146,000
1916	344,000	1922	339,000
1917	562,000	1923	405,000

The largest transformers so far built in this country were the 19,500-kVA, 3-phase, 50-cycle transformers for the Barton station of the Manchester Corporation, and the 7,800-kVA, single-phase, 25-cycle transformers for the Dalmarnock station of the Glasgow Corporation. The latter size corresponded to 15,000 kVA at 50 cycles. Both these sets of transformers were of the oil-immersed, forced-cooled type, with oil circulating through external water coolers. The 19,500-kVA Barton transformers were transported to the site in their tanks, complete with oil, the total weight being 60 tons. British manufacturers had already delivered to the Colonies transformers for 110,000 volts and outdoor transformer sub-stations were now in operation in England, in many instances at 22,000 and 33,000 volts, and in one case at 66,000 volts. The majority of those transformers were connected to e.h.p. underground cables, which were led into the transformer through ironclad cable-sealing bells, or trifurcating boxes, of weatherproof construction. In agricultural districts there was also a tendency to place small distribution transformers out of doors, either mounted on poles or concrete platforms. Three-phase transformers for cable testing up to 300,000 volts had recently been built in this country and single-phase sets for insulator testing up to 500,000 volts.

Armour-clad switchgear had been adopted for systems up to 35,000 volts, individual breakers having a rupturing capacity of 1,500,000 kVA; all connectors were insulated and embedded in compound. American practice had developed in a different direction, phases being completely segregated from each other. Outdoor switchgear had been developed to match transformers. The first station of this type to go into service was that at High Street, Manchester, and similar gear was being installed at other places. Pole-mounted switchgear was also increasing in use, several schemes being in progress.

The greatest progress in industrial plant had undoubtedly been made in steel works, and in 1921 there were more than 600 electrically-driven rolling mills in this country, the largest having a maximum rating of 21,000 h.p. About 300 mill motors had a normal rating of 300 h.p. or above. An interesting application of electrical driving was in tire mills, a number of which had been electrified. Owing to the changing ratio of inside to outside diameter of the billet in roughing the speed of the rolls must have a variable ratio; this was obtained in a simple way by providing a separate motor for each roll and connecting them in series. Practically all large reversing mills installed in recent years were electrically driven and had proved an unqualified success. In 1921 the number of electrically-driven rolling mills in the United States of 300 h.p. and above was over 700, totalling over 1,000,000 h.p. A recent statement gave the total horse-power of electric motors employed in the steel industry of that country as 5,000,000 h.p.

Owing to the depressed state of the coal industry comparatively small progress had been made as regarded the installation of electrical plant in collieries, excepting winders. The need for increased output from the pits had brought the electrical winder into its own. An interesting development was the S.P. scheme. Briefly, it consisted of a turbine driving d.c. generators through gearing with a flywheel mounted on the shaft of the generators. By a special governor the speed of the turbine was reduced when peak load occurred, thus allowing the flywheel to give out its stored energy. In connection with Ilgner sets, by adopting special high-grade materials which permitted high peripheral speeds, it was possible to obtain 3.25 h.p.-seconds of stored energy per lb. weight of the flywheel.

This year had been remarkable for the demand for electrical plant in the United States. Turbo-generators of 62,500 kVA capacity in one machine were under construction. The speed of these sets was 1,200 r.p.m., the frequency being 60 cycles, and the weight of the rotor of one of these machines over 100 tons. Waterwheel generators having an output of 45,000 kVA had been in successful operation for about two years in the Queenston power house of the Ontario Power Commission, and additional sets, each having a capacity of 55,000 kVA, were under construction.

For the Niagara Falls Power Co. two sets, each having an output of 65,000 kW, would be installed. The rotor of one of these generators was built up of ten rings, side by side, each weighing 40,000 lb., the diameter being 23 ft., and the total weight of each machine over 700 tons. In 20 years the size of individual sets built for that company had increased 17 times—a truly remarkable development.

As an example of what was being done in "linking-up," it might be mentioned that a frequency changer of 35,000 kVA capacity was being installed for the purpose of interconnecting the 25- and 60-cycle systems of the New York Edison Co. Other sets of 15,000 to 20,000 kVA capacity were under

construction, and synchronous condensers for transmission-line regulation having a capacity of 35,000 kVA had been installed.

A notable advance in high-pressure transmission work was the putting into commercial service of the 220,000-volt system of the Southern California Edison and the South Pacific Gas and Electric Companies. This is the highest voltage yet adopted for commercial work. Some indication of the size of oil switches required might be gathered from the following figures:

Weight of switch with oil	45 tons.
Oil required	2,000 gallons per pole.
Height to top of terminal	17 ft. 6 in.
Size of tanks	8 ft. x 5 ft. x 8 in.

Railway electrification was being undertaken on a large scale and one of the most remarkable developments in America was the "Supervisory Control" system. Two methods of achieving control had been developed: The first was a system of relays and signalling devices, which linked up all the stations to be controlled, and was termed "audible supervision," being mainly adopted for hydro-electric plant and small sub-stations. The supervisor could at any time put himself into telephonic communication with any station by means of a specially developed keyboard and automatic dial, and by means of audible signals he could ascertain the head of water, gate opening, &c., the signals being repeated automatically until another dialing operation was made by the supervisor. Trouble alarm circuits could be used, the warning being obtained by high-frequency current received by a loud speaker in the supervisor's office.

The second system was "visual control," developed for large systems with a number of large sub-stations. For each operation in the sub-station there was a definite numerical code. The signal was transmitted by telephone keys that operated relays which, in turn, operated an automatic selector switch. Through the latter the code was transmitted to the station and decoded by a similar selector switch which operated the relays required to perform any desired operation, such as closing a circuit breaker. The relays signalled back to the supervisor the fact that the required operation had been performed, and small lamps were used for this purpose, hence "visual control." The relays and selector switches were those used for standard automatic telephone work, so that the system did not depend on experimental plant.

Incorrect operation was almost impossible because the whole operation was reported back to the supervisor.

He had inspected an experimental equipment and it was almost uncanny in its operation.

The tramway company in Cleveland, Ohio, operated four automatic sub-stations which were also controlled by a supervisor located in the offices of the company, who had full control of all the plant through two pairs of telephone wires.

THE MISUSE OF THE INTERNAL-COMBUSTION ENGINE.

Suggestions for its More Efficient Application.

A PAPER dealing with the above subject was recently read by Mr. L. MURPHY before the INSTITUTION OF AUTOMOBILE ENGINEERS. The author's argument will probably form the focus of much useful discussion and the gist of it is accordingly indicated below.

In many of the more notable successes in the art of applied engineering the employment of a compromise has frequently been of great value in producing a well-balanced and economical result, but it is somewhat to be deprecated that the tendency to over-specialisation has caused criticism, frequently, to go far beyond its sphere of usefulness, and has thus stunted such development as may accrue from true co-operation between specialists in varied branches of the art.

In road locomotion steam, electricity, and petrol could each claim that it did not suffer from serious disabilities manifest in the other two, and in consequence each type has developed in a field of restricted maximum usefulness. It does not appear that engineers have asked themselves very seriously what must be the ultimate objects in road-vehicle design.

The petrol-driven vehicle with which we are most familiar fails lamentably in some essential qualities. It takes an appreciable time to start, even if the engine is first rotated by an electric motor, and its average speed, as indicating its time-economy merit, is always far below the maximum of which it it capable under favourable conditions; also in average practice not more than one-third, and very rarely more than one-half, of the possible engine output per unit of fuel consumed is obtained on the road. If the engine gave the same efficiency on the road as can be obtained readily on a bench test the ton-miles per gallon should approximate to 125, allowing for actual known figures with regard to road resistance and gearing efficiency, but in commercial operation the owner of a lorry may consider himself fortunate if he obtains one-half of the result which should appear possible.

The results in the case of an electrically-propelled lorry of similar gross weight and transmission efficiency actually prove that in commercial service it is possible to propel the load for 80 watt-hours taken from the battery per ton-mile travelled. (This result is obtained daily by carriers of goods, even within the Metropolitan area.) If the "efficiency of application" of the petrol engine could be made equal to that of the electric motor it should be possible to obtain no less than 142 ton-miles per gallon of petrol for the particular weight class of lorry. The actual result obtained under commercial conditions is usually about 40 ton-miles per gallon unladen, and perhaps as high as 65 ton-miles per gallon fully laden. In traffic these figures will frequently be reduced to 20 ton-miles per gallon even with perfect engine and chassis adjustment and skilled driving.

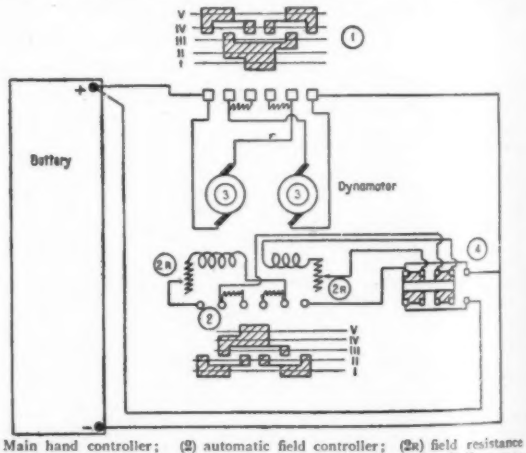
For the fuel cost of an electric lorry of which the battery is charged from a petrol-engine-driven dynamo the following figures are fairly representative:—

Petrol consumption of engine	0.075 gallon per b.h.p. per hr.
Efficiency of dynamo	80 per cent.
Energy efficiency of battery...	68 ,,
Efficiency of vehicle motor ...	85 ,,
B.h.p.-hours required at cardan shaft per gross ton-mile	0.091

Then the brake horse-power hours which must be developed by the engine per ton-mile travelled =0.197, and therefore petrol consumption per gross ton-mile =0.0147 gallon, or ton-miles per gallon=68.

We thus arrive at the surprising result that it is possible to burn petrol in a stationary engine, convert its output to electrical energy, store this energy in a battery, withdraw it from the battery and re-convert it to energy of motion, and finally arrive at a consumption which is appreciably less extravagant in fuel than the present methods of direct engine application.

While, therefore, engine designers have used their utmost endeavours to improve the efficiency of their creations, the method of application to the chassis continues to cause losses



(1) Main hand controller; (2) automatic field controller; (2a) field resistance (varied by pedal); (3) armature sections; (4) reversing switch. Full connections from left-hand field section to lower side of reversing switch similar to those from right-hand field to top side of reversing switch, but omitted for simplicity.

FIG. 1.—"DUAL-POWER" CAR, DIAGRAM OF CONNECTIONS.

enormously in excess of the savings which have resulted from many years of research on engine design, and the orthodox petrol vehicle of to-day must be condemned as a fuel-wasting monstrosity.

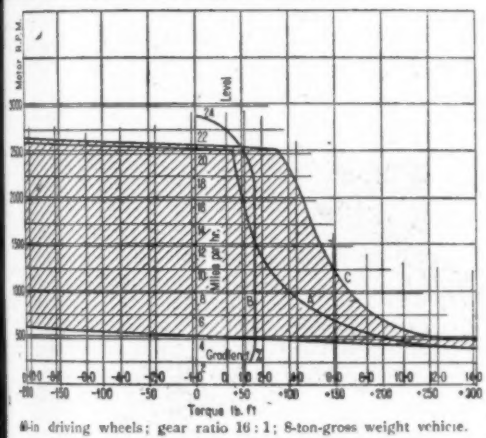
What, then, is the indictment with regard to time-economy? Many investigators have realised the limitations of the gear-box drive, and ingenious substitutes have been proposed, but it is questionable whether any one of the systems has given results which fully justify the increased capitalisation which is involved.

From representative curves of petrol consumption related to engine torque output taken at various speeds it is evident that the object of any gear-ratio change mechanism should be to keep the engine at approximately full torque and to cause such variation in its speed as will enable the necessary power output to be obtained under any specific road conditions.

There is no hope, however, of attaining a performance

proaching best test-bench figures for fuel economy by the riable-ratio method as at present used, since this method not possibly be extended to meet the full range of require-nts, and, although some of the more recent electrical "gear-ss" are theoretically much superior to the orthodox gear-s, variation of the amount of throttle-opening (or the rque-loading of the engine) is still relied on for speed control, d the driver is able, and is compelled at times, to operate engine in a most wasteful manner.

It would appear to be futile to endeavour to improve the rmal efficiency very greatly unless the mechanical efficiency low torque and high speed can also be greatly improved. The steam engine, as a type, offers considerable scope for ught, particularly if it be considered as a reversible expan-n engine. Durtnall has suggested that steam should be mpressed and at the same time super-heated in the cylinder ce on the under-side of the pistons of an internal combus-n engine. Further heat may be added from the exhaust d the whole then utilised in an expansion engine geared to road wheels. The exhaust from this engine would then s back at low pressure to the petrol engine cylinders to be ompressed and re-heated and thus admitted again into the nsion engine for utilisation. Added features are a small er for generating the initial supply of steam and a storage mber to take up any excess steam generated or to provide r sudden demands by the expansion engine before these can met by fresh generation. From a theoretical standpoint s scheme appears to have great advantages and intrinsic rit of the first order, and the author looks forward to its ctical development with great interest.



6in driving wheels; gear ratio 16 : 1; 8-ton-gross weight vehicle.

g. 2.—Controlled Shunt-Motor Equipment, Plus 2,000-c.c. Petrol Engine With Fixed Throttle.

In a "dual-power" scheme consisting of a battery-driven ctric vehicle with a small petrol engine added, it is obvious at it should be quite possible to keep the engine working at ctically full throttle at all times, except when the vehicle is sting (or nearly so), which condition may be met by cutting e engine out completely with a clutch, so that, provided the gine is not too large, it can be operated for the whole time any fixed throttle-opening which may be desirable. Since rottle-opening is the main factor affecting economy, it is dent that the engine may be operated at its maximum nomy. Furthermore, the engine power so added to the ctrical equipment will be transmitted direct to the road eels, and the additional ton-miles obtained will be at the rrespondingly economical rate.

Taking, again, the case of a lorry weighing 4½ tons unladen d 8 tons fully laden, but in this case electrically-driven and th the addition of what would appear to be an absurdly all petrol engine, say, 1,000 c.c. capacity; consider also that clutch is introduced so that it is possible to start or stop the gine at will, and assuming that the same average efficiency n be obtained for the electric motor under these conditions when operating solo, it may be deduced that by the dition of this small engine the mileage per battery charge y be increased in the ratio of at least 3 :1, so here is a mple means of extending both the radius of action and speed an electric vehicle to an amount which makes it a practical chine for almost any purpose. The only additional control uired is a means for declutching the engine when the speed comes excessive.

The engine must contribute approximately 0.091 brake horse-wer hours per additional ton-mile, and, allowing for all con-gencies, this will be obtained for a consumption not exceed-g 0.008 gallon of petrol per ton-mile (*i.e.*, 125 ton-miles per llon).

Adding an engine to a shunt-excited motor merely causes down-hill condition of negative torque to occur on the el, but does not raise the speed by a measurable amount. is type of motor has the valuable characteristic that its ed is not noticeably affected by the engagement or disen-gement of the engine, but for this to be of service it must possible to drive at a higher normal speed when the ficient will not thereby put an excessive load on the battery.

For this purpose the author has devised the scheme shown in fig. 1. The shunt-excited motor's speed may be varied by regulating its field excitation by an "accelerator" pedal; in addition, an automatic master controller is provided, which prevents the field being weakened by the driver beyond the safe limit for any particular condition of gradient or load. The result is curve A, fig 2, which has the same general characteristics as a series motor from the point corresponding to level running up to the most severe gradients, but the driver can, by selecting speed, work on any point within the shaded area. This system of control is almost ideal from the driver's point of view, because any chosen position for the "accelerator" pedal or control lever corresponds to a fairly definite speed. Furthermore, a depression of the pedal brings into action immediately the additional torque for acceleration, while the release of the pedal produces a braking action by regeneration until the lower desired speed is established. In the majority of driving, therefore, the use of a separate brake becomes superfluous, and the greater part of the energy usually wasted in braking is automatically saved.

Having now established an electrical scheme which will maintain the speed of the vehicle approximately constant under widely varying conditions of torque, it is possible to select an engine size from which the average output on a fixed nearly full open throttle is sufficient to meet the average demand for propulsive energy. This engine, in the example chosen, will be about 2,000 c.c. capacity, or, say, 2,200, to allow a margin for the contingencies which arise in practical operation. A typical torque-speed curve for such an engine is B, fig. 2, and curve C shows the maximum performance obtainable by compounding the engine and motor curves. As in the case of curve A, the driver can, at will, drive at any speed on the ordinate corresponding to the gradient condition provided such speed comes within the curve C as shown by the dotted shading.

To comply with the maximum discharge-rate of 27 kW per ton of battery, a battery weighing two-thirds of a ton should be sufficient in this application dealing with a gross load of 8 tons, while the engine is sufficiently large to contribute as much as may be desired to the charging energy required by the battery. The radius of action of the vehicle has, therefore, been extended to a point which is only limited by the amount of petrol carried, plus the additional energy stored in the battery at the start. It does not follow in commercial operation that it would be most economical to derive all the propulsive energy from the petrol carried on the vehicle, since, in cases where cheap electrical energy is available, the battery could be charged in just the same way as with a purely battery-driven vehicle.

It is probably safe to assume that in average practice at least 60 per cent. of the energy at the road wheels may be obtained direct from the petrol engine, and therefore at the rate of 130 ton-miles per gallon. The remaining 40 per cent. will either be obtained as double-converted energy at 68 ton-miles per gallon or as energy from the battery-charging mains at a rate equivalent to about 150 ton-miles per gallon, so that under extremely unfavourable conditions the mechanism should operate for a consumption not in excess of 90 ton-miles per gallon, while under the best conditions a result equivalent to 130 ton-miles per gallon should be easily realisable.

This method of operation, therefore, appears to offer the possibility of very substantial fuel economy, and it should be noted particularly that the factors determining this economy are almost independent of whether the vehicle is run in a light or loaded condition; furthermore, the economy of running cannot be greatly affected by the way in which the driver manipulates the controls.

The only factor which varies greatly with the load carried is the proportion of time during which the engine must be run, and the driver can readily determine when it is absolutely necessary to run the engine from the indications of an ampere-hour meter. Since the engine is worked at practically constant torque and only through a limited range of speeds, a much more favourable set of conditions is established for the employment of heavy fuels, so that apart from the intrinsic economy of the method, it opens up the way to substanital economies in other directions. The gross weight of the vehicle would not vary more than 2 or 3 per cent. from that of a normal petrol layout, and would certainly be lighter than the heavier machines of the latter class.

Psycho-galvanic Phenomena. — Some account of the change in bodily resistance known as the psycho-galvanic phenomenon was given by Dr. R. H. Thouless, senior lecturer in psychology at Manchester University, at a meeting of the Manchester Literary and Philosophical Society on November 6th. He uttered a warning against the tendency to read an exaggerated significance into the results, and said there was no justification for calling the instrument an "emotometer," thus implying that it provided a direct record of emotion.

Touching on the kind of problem which one might hope to elucidate with the help of this apparatus, Dr. Thouless said that in the Manchester Psychological Laboratory they were applying it to the investigation of dreams.—*Manchester Guardian.*

THE ALL-BRITISH WIRELESS EXHIBITION.—I.

The All-British Wireless Exhibition and Convention organised by Messrs. Bertram Day & Co., Ltd., was opened by the Postmaster-General, Sir Laming Worthington-Evans, at the White City, Shepherd's Bush, on the 8th inst., and will remain open to the public until November 21st. There are some 113 exhibitors, the show being the second annual one of its kind, but the first to be held in conjunction with the National Association of Radio Manufacturers. It is an unparalleled opportunity for the British Broadcasting Co., Ltd., and the industry as a whole co-operatively to demonstrate to the public the simplicity and delightfulness of broadcast radio reception, and how worth while such an admittedly inexpensive form of recreation is.

The size and scope of the exhibition show plainly how the public has been attracted by "wireless," and the manner in which manufacturers have seized the opportunity for doing business is revealed by the fact that although the industry is not much more than a year old, it is estimated that some 600 British firms are catering for the needs of its devotees. Quite apart from the business that will be stimulated by the show, its advertising value will be by no means insignificant now that the tide, so recently at a low ebb, is flowing again.

The exhibition, at which every British firm of repute is represented, is essentially an "amateurs'" show; to the novitiate the difficulty will be fully to appreciate the progress that

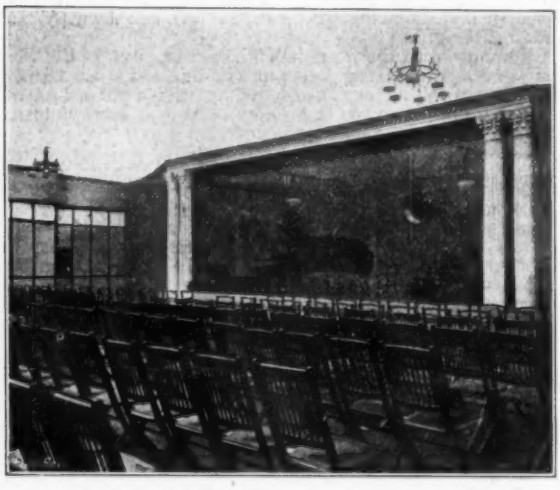


Fig. 1.—B.B.Co.'s Demonstration at the Exhibition.

has been made during the year, for notwithstanding that new ideas are not conspicuous, the exhibits clearly indicate the improvement that has been made in both performance and workmanship.

With regard to complete receivers, there is a wide choice from simple crystal sets of small dimensions to multivalve and "loud-speaking" sets made to represent any style of furniture in handsomely elaborate cabinets. New thermionic valves, mostly of the low-temperature or "dull-emitter" pattern, are in evidence, and a feature of the exhibits is the "unit" construction adopted by a number of firms—the sets being always complete, but easily capable of extension at any time; complete sets of parts for assembly by the purchaser are also to be seen on several stands.

An innovation this year is a demonstration hall, fig. 1, wherein a stage has been arranged as an exact reproduction of the studio at the British Broadcasting Co.'s London station. There concerts similar to those of 2LO will be given as they are at Savoy Hill, so as to give the public some idea of how broadcasting is done.

In the words of the Postmaster-General, "Wireless has a short past, a flourishing present, and an immense future," and we hope with him that "this exhibition will serve to demonstrate some of its potentialities and to encourage a new and promising British industry."

The Exhibits.

On the stand of the Radio Society of Great Britain are displayed maps on which are indicated the positions of all radio societies in the Metropolis and throughout the country. In addition, there is an exhibit of radio apparatus of general interest to experimenters as well as selected entries for the competition open to members of all affiliated societies, for the best examples of amateur work, for which prizes are offered.

Messrs. Hazeltine Neutrodyne Radio Sets, Ltd., are showing, in addition to frame aerials and "loud-speakers," a range of instruments in the construction of which use is made of the "Hazeltine Neutrodyne" circuit, the design of which follows the invention of the American investigator Prof. Louis A Hazeltine. This company has the sole rights of manufacture in this country of apparatus utilising this circuit. The instrument is enclosed in a polished wooden case with a sliding glass front, fig. 2, all the exterior connections

Fig. 2.—The Neutrodyne, Front View.

being so arranged that the instrument can be closed up after adjustments have been made. With the exception of the aerial and earth connections there are no terminals, plug connectors being provided for the high- and low-pressure batteries, telephones, &c. A small switch is provided for breaking both battery connections, being so arranged that those of the l.f.

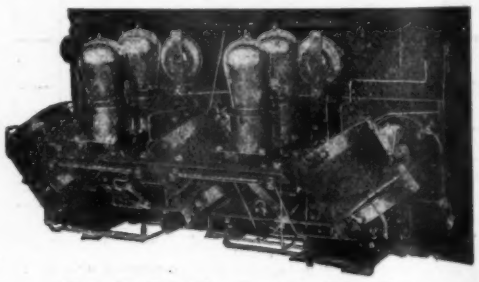


Fig. 3.—The Neutrodyne, Rear View.

battery are broken a fraction of a second earlier than those of the l.p. one to avoid undue stresses being set up in the transformers. The circuit arrangement has received favourable comment owing to the stable non-distorting, non-radiating, and overall efficient qualities claimed for it. Fig. 3 is a rear view of the set.

The set illustrated above is the result of research carried out by Prof. Louis A. Hazeltine into methods of avoiding capacity coupling, and his method consists of balancing out completely, the undesirable capacities of the various components. The system embodies four valves, of which there are two h.f., one detector, and one l.f., the first h.f. being used also as a l.f. amplifier so that the scope of the outfit is practically equivalent to that of one employing five valves. The practical achievements resulting from the use of the "Neutrodyne" method are, briefly, the elimination of interference and avoidance of distortion, together with selective and permanently stable tuning, so that a set once adjusted to a particular station can be simply switched in or out as required without any further manipulation.

The Metropolitan-Vickers Electrical Co., Ltd. One of the chief features of this exhibit is "Cosmos Radiobrix," a set of which is illustrated in fig. 4. They are a range of units of uniform size and shape by means of various combinations of which the experimenter or amateur can build up any type of receiving set, or circuit, and can employ any desired number of stages of high- or low-frequency amplification. They have been designed with the object, not merely of putting them together to make up a standard form of set but with a view to securing the utmost flexibility, so that they may be connected-up in every conceivable way, and an excellently useful book of diagrams is supplied illustrating representative circuits. "Radiobrix" are mounted in polished mahogany boxes, carrying ebonite panels; they are mostly of a uniform size of 5 in. x 5 in., but in the few cases where larger panels are necessary the dimensions are a multiple of 5 in. Thus appearance has not been sacrificed.

The new 6-valve, type VS.4, is a supersensitive set fitted with a self-contained frame aerial, and also with terminals for connecting up an outside aerial and earth-lead for long-range work. The set is said to be highly selective and comprises three high-frequency amplifying valves, a carborundum crystal detector, and three low-frequency amplifying valves

The high-frequency vario-transformers are coupled together, so that simultaneous tuning of all three inter-valve circuits is effected by the movement of a single knob. Non-radiating adjustable reaction coupling is also employed, and fine tuning is thus obtained over the whole range of wave lengths with simple adjustment. The crystal detector is screwed up tight, and there is no need to search for a sensitive spot. It is adjusted by means of a potentiometer, and once this is set it will remain for weeks without needing further adjustment.

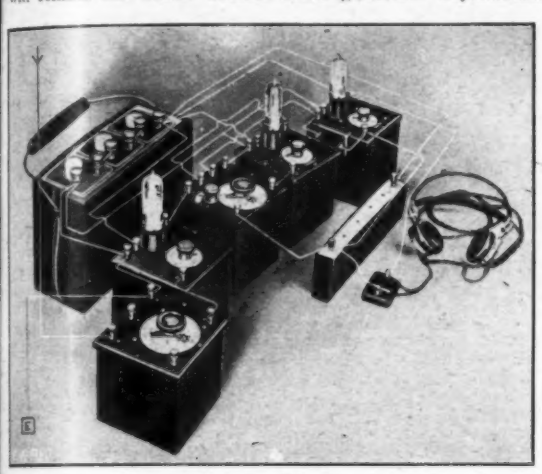


Fig. 4.—"Cosmos Radiobrix."

A pair of head-telephones is connected to a plug, which may be inserted in one or other of two "jacks," according to the strength of signals. When in the first jack the telephones are connected to the first low-frequency valve; on plugging into the second jack they are connected to the second l.f. amplifying valve. In each case the loud-speaker is cut out and the current is cut off from the valves not in use. When head-telephones are not plugged in, the loud speaker is automatically

Fig. 5.—"Cosmos" Loud-speaker Set.

connected to all three l.f. valves. Two or more head telephones may be connected in series. The apparatus is mounted on a single panel of ebonite, either in an outer case of oak or mahogany, arranged to stand on a table for use with a separate loud-speaker, or in a cabinet which also contains a loud-speaker and horn, fig. 5, built entirely of wood. The frame aerial fits inside the lid of the case or cabinet when not in use. The Cosmos valve sets are designed on a "unit" principle. Type VS.1 set, fig. 6, consists of a two-valve tuner unit, with the necessary batteries and telephones; the addition of a 2-valve note-amplifier unit converts this into a 4-valve set (type VS.2). Each unit is connected to the next by a single plug and the units may be used by themselves, or assembled

Fig. 6.—"Cosmos" 2-Valve Radiophone.

in an outer case or cabinet enclosing a loud-speaker and horn. The sets are arranged for dual-amplification and non-radiating reaction coupling of a type which complies with the Post Office requirements.

Climax Patents, Ltd.—The "Climax monovalve" set employs a single valve in conjunction with a crystal circuit.

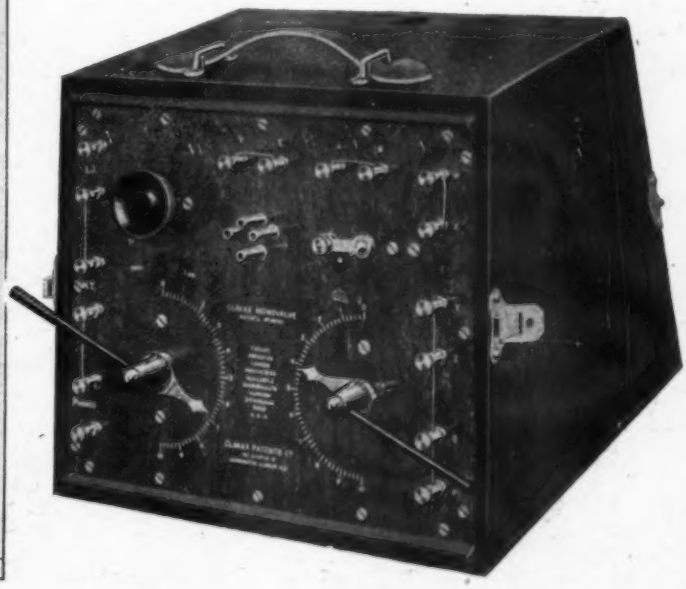


Fig. 7.—The "Climax Monovalve" Set.

It would seem that such a circuit, if it is to be a success with the uninitiated public, must possess a considerable measure of stability and not need too critical tuning. Such a receiver, fig. 7, if the claims made for it can be fulfilled under every-day conditions, should have a considerable future ahead of it. It is understood that the crystal circuit is not used for detect-

ing, but as a "damping resistance." The set requires no earth connection, and, with its folding frame aerial, is as portable as a small gramophone, and it is claimed to be very selective and to have a long range; for example, the standard test is to tune out the London station at a distance of three miles and

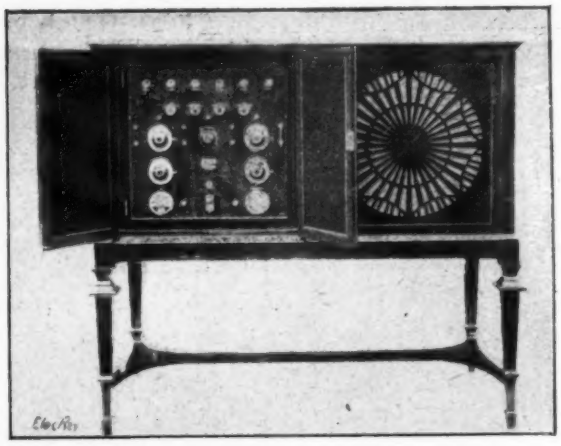


Fig. 8.—"Aristocrat" 6-Valve Set, Front View.

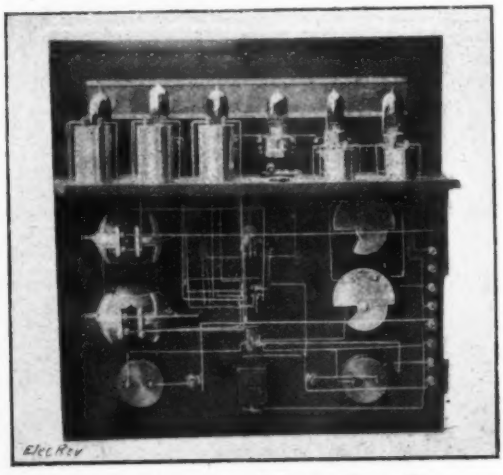


Fig. 9.—"Aristocrat" Panel, Back View.

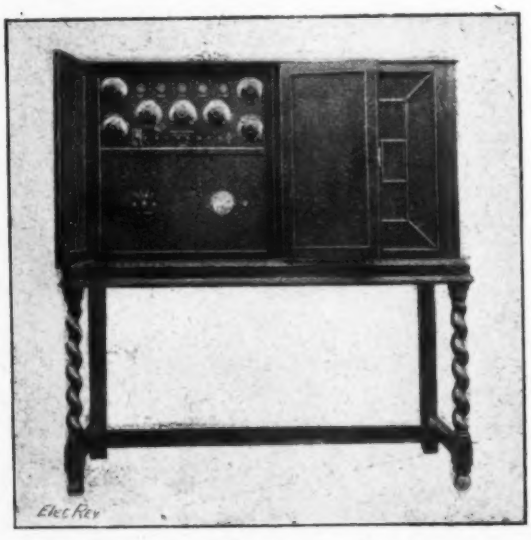


Fig. 10.—"Country House" 5-Valve Set.

to receive any of the other British stations as well as Paris. The makers specifically guarantee each and every "Climax" set to pass this test. The standard set and No. 1 frame aerial is adjusted for a wave-length range of from 300 to 500 metres, but for longer lengths a loading coil can be connected with another in series with the aerial. The "Monovalve" set is a well-made and finished instrument, and for those who wish to use a loud-speaker provision is made for additional stages of low-frequency amplification to be successfully added as required.

The General Radio Co., Ltd. (affiliated with the Cox-Cavendish Electrical Co., Ltd.).—At the head of a large range of complete B.B.C. receiving sets is the "Aristocrat" (G.R.C. 58). This is a 6-valve "loud-speaking" equipment, to which certain improvements have recently been added; it still retains, however, the appearance and efficiency which attracted favourable attention at the two preceding radio exhibitions held in London. We illustrate the complete cabinet, fig. 8, and also a view of the back of the panel, fig. 9, which shows clearly the shielded variometers, high- and low-frequency transformers, and the square busbar wiring so distinctive of the company's apparatus. Other exhibits include the G.R.C. 16 2-valve set, the G.R.C. 13 2-stage note magnifier, the G.R.C. 14 3-stage note magnifier, and the company's "loud speaker." Fig. 10 illustrates the 5-valve "Country House," "loud-speaking" model of the Jacobean cabinet style and the inclusion of the G.R.C. variometers, vario-couplers, high- and low-frequency transformers and other components makes the stand a comprehensive one, and well worthy of inspection.

The Ever-Ready Co. (Great Britain), Ltd., exhibits various type of dry cells and also Leclanché, inert, and h.p. types. Dry h.p. batteries, tapped at every three-volt stage, and fitted with "Wander" plugs, are on view, as well as "units" for building up high-pressure batteries of cells for radio work. On this stand are demonstrated the effects of "Hercules" l.p. batteries when used with "dull-emitter" valves.

The Hart Accumulator Co., Ltd., shows l.p. and h.p. batteries in addition to general types of accumulators and portable hand lamps. A set of 17 cells (32 volts), as supplied for radio transmission on board ship, is also shown.

The Solidite Manufacturing Co., Ltd., is exhibiting a wide range of moulded parts, including knobs of all descriptions, variometers, valve holders, slides, coil plugs, fixed condenser cases and variable condenser ends, telephone earpieces, &c., which indicate the great variety and shapes that can be obtained by the use of "Solidite."

The Formo Co. (Arthur Preen & Co., Ltd.), has on view a large collection of component parts and accessories, amongst which are transformers, filament rheostats, and crystal detectors, some of which are of the plug-in pattern for use with valve sets. Such things as condensers, lead-in tubes, variometers, terminals, screws, and small brass parts are also shown.

RURAL DISTRIBUTION OF ELECTRICITY WITH RETURN BY EARTH.

In the *Revue Générale de l'Electricité*, of August 28th, 1923, M. Georges Viel, director of the Compagnie Electrique de la Loire et du Centre, deals with the question of supplying electricity in rural areas for agricultural purposes by means of cheap transmission lines. He states that the chief obstacle to the extended use of electricity in farming, &c., is the high cost of the mains, owing to the small power required, and the scattered nature of the load. To cope with this difficulty, he has investigated the distribution of energy by means of single-phase lines at high pressure with return by earth; this would necessitate the repeal—at least in the case of rural areas—of a Government regulation forbidding the use of the earth as part of a distributing circuit. In view of the low value of the current, he considers that there would be no risk of disturbing the operation of telegraph and telephone lines. This regulation, says M. Viel, continues in existence simply because, hitherto, no one has asked for its repeal; numerous articles have been published showing that the problem can generally be solved in a manner satisfactory to all parties concerned. Two reports by MM. Barbillion and Brylinski, on experiments carried out between Lancey and Grenoble, in 1906-7, are cited, from which it is deduced that the disturbing effects of an alternating current of 30 amperes at 11,000 volts, on a twin telephone circuit carefully spiralled, are "practically negligible." The line tested at Lancey was 2.5 km. in length, and was at a mean distance of 8.25 m. from the power line.

The author gives details of the comparative cost of a single phase, iron-wire line, with earth return, and a three-phase line of the normal type, at 10,000 V in each case, the line being designed to transmit 10 kW to a distance of 15 km., with a loss of 4 per cent.; the single-phase line costs 4,870 fr., whilst the three-phase line costs 10,400 fr.—more than double the former—whilst the transforming apparatus is also less costly for single-phase (8,500 fr. compared with 10,100 fr.). A typical (hypothetical) case of supply to three villages is given by the author, who also briefly deals with the adverse effect of the proposed system on the power factor, and dismisses it as of little importance owing to the small currents concerned. The advantage of the single-phase earth-return system diminishes as the magnitude of the load and the distance of

transmission increase, but even when these are such that the three-phase system becomes preferable, he would use only two insulated wires, the earth being used for the third, and thus economising in copper, insulators, and poles. Further economies are due to the regulation fixing a minimum size for the conductor (3 mm.), and to reduction in the surface exposed to the wind, permitting lighter poles or longer spans to be used; the author recommends iron poles of I section, in place of wood, in view of successful results which he has obtained with the former. The fall of pressure in an iron-wire line carrying 5 A is about 10 times that in a copper line of the same section.

The precautions necessary to take when the earth is used for the return circuit relate to the distribution of the pressure near the earth-plates, and to the action of the system on telephone or telegraph lines. Danger to life, especially in the case of cattle, may result from too steep a pressure gradient in the soil. Experiments have been made with earth-plates at various depths in fields, leading to the following conclusions: The fall of pressure should not exceed about 20 V per metre. A galvanised iron plate buried in coke or charcoal to which a conducting salt such as copper sulphate has been added is suitable, and should be at a depth of 2 to 4 m., according to the locality. The conductor should be soldered to the plate and carefully insulated from the soil. Additional plates, pipes, &c., to increase the metallic surface may be necessary in some cases, and if the ground is rocky, the site of the plate should be covered with material of low conductance and enclosed on a circumference of 3 or 4 metres.

With regard to inductive disturbances, the above-mentioned experiments of Messrs. Barbillion and Brylinski on a single-phase transmission line carrying 30 A, at 11,000 V, 42 cycles per second, and about 14 km. long, are quoted as showing that the disturbing effects on a spiralled telephone line at a distance from the h.p. line varying from 8.25 to 477 m. were practically negligible. The P.L.M. railway paralleled the line under test at a distance of about 500 m., and no effects on the working of the telegraphs or signals due to the earth current were reported. With the aid of single-wire telegraph lines in the vicinity of the test line the pressures induced in the former were measured; it was found that on a stretch of telegraph wire parallel with the h.p. line for a length of 2.5 km., and at an average distance from it of 8.25 m., the pressure induced per ampere was 563 milli-volts. Pressures due to other sources reached 370 mV. In the case of lines about 500 m. distant, the induced pressure per ampere was 310 mV., whilst other influences gave rise to pressures reaching 340 mV. The author concludes that for the small currents with which his article is concerned, the disturbances produced will be less even than those experienced from other causes.

With regard to distribution at low pressure, M. Viel points out that the use of the earth return for this purpose is impracticable, owing to the inherent resistance of the connection with earth, which is too great to permit of economical results. Low-pressure distribution would therefore be effected with two copper wires, which would not be more expensive than the three-phase four-wire system.

The only obstacle to the use of the earth as a conductor is the regulation already referred to. That the earth return will be used at no distant date, the author is convinced, for "there is no reason why this marvellous conductor, the earth, should not be utilised." The question is urgent for the sake of the distribution of the small powers required in rural areas; the economy that would be realised by the use of single-phase lines with earth return is so important as to justify the modification of the regulation, to permit the use of the earth under certain conditions as to power, pressure, and current.

A REVIEW OF SWISS INDUSTRY.

A quantity of interesting information regarding the Swiss electrical and allied trades is contained in a report which has recently been issued by the Committee of the Swiss Commercial and Industrial Association.

It recalls that 1922 may be regarded as the most depressing year through which Swiss engineers ever passed. The set-back to exportation, and the persistent slackness on the home market, led to the dismissal of workpeople and the actual closing of certain works.

The depreciation of the exchanges in Central Europe added so greatly to the difficulty of doing export business, that in order to secure a contract the Swiss firm, it is stated, had often to sell below cost. At the same time foreign competition was having a disastrous effect in the home market. There is hope that better conditions will prevail in trade with Spain and Italy now that commercial treaties have been concluded with those countries. The agreement for an exchange of commodities with Rumania brought some useful orders for machinery. The Committee pleads that the State departments as well as private enterprises should adopt the principle of placing their orders with home firms. A certain decline in the cost of living has enabled employers to reduce wages to some extent, but it is pointed out that the standard is still above that of Switzerland's principal purchasers or competitors, and that the country's chances of obtaining foreign orders for machinery are consequently poor. More intensive labour, coupled with improvement in works' equipment, is considered as the only means towards strengthening the position of the industry.

The report records that progress has continued in the work of the Bureau of Standards of the Swiss Engine-builders' Association, in collaboration with similar associations in other Swiss industries and abroad. It proceeds to deal in detail with the different branches of the industry. Locomotive builders have benefited by the work of electrifying the State railways, but the total volume of orders executed by the electrical machinery manufacturers has been much below normal. The sole hope of the industrialists lies in the railway work at home. All thoughts have been turned to the question of reducing costs of production. In one branch of the industry it is calculated that the adoption of a 54-hour week would permit of a 15 to 20 per cent. increase in output. In another section it is reckoned that a similar extension of the hours of labour would bring about a 20 per cent. reduction in general costs. A decrease in railway and postal rates is also considered essential.

There was a slight recovery in the sales of incandescent lamps and it is noteworthy that nearly all the supply companies have made a practice of placing their contracts with Swiss makers.

The October issue of *Swiss Industry and Trade* gives the following report of the progress made in the electrification of the Swiss Federal railways, communicated by the Secretary of the Swiss Society of Engine-builders:—

"Since May, 1922, the last section of the Gothard line—between Goldau and Lucerne—225 km. long, has been worked electrically, so that the great line of communication from north to south across the Alps has now entered upon a new phase in its history. As soon as the manifold advantages of electric traction had been ascertained in Switzerland it was decided to speed up the electrification of the Federal railways, and by 1928 electric trains will be run on a total length of 1,529 km. The total costs involved in the setting-up of electric traction will amount to 750,000,000 fr., 520,000,000 of which will be devoted to the construction of electric power-houses, sub-stations, high-pressure lines, contact lines, &c. The remaining 230,000,000 will be used for the purchase of rolling-stock; 400 locomotives and cars will be required for the working of the different lines provided for in the aforesaid programme; 141 locomotives have already been or are now being completed. The electrification works have been undertaken exclusively by Swiss industry. The mechanical parts of all the engines have been supplied by the Swiss locomotive building works at Winterthur; the electrical parts by the Brown, Boveri & Co. Works at Baden, the Oerlikon factory, and the Sécheron Works, Ltd., of Geneva.

If the traffic of the year 1913 is taken as a a basis of calculation, it becomes apparent that the cost of running electric trains (allowing 5 per cent. interest on the invested capital and 60 fr. per ton of coal delivered at the Swiss frontier) is not higher than the expenditure incurred in steam traction. The greater the traffic the more profitable will electric traction prove, and when a length of 1,529 km. of railway is electrified the running of electric trains will save 530,000 tons of coal per annum, assuming that the passenger and goods traffic remains the same as in 1913."

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents.

The name of the applicant's patent agent, if any, will be found on the printed specification.

26,491. "Wireless receiving sets." L. G. Bacon, T. H. Coates, and H. Hiley. October 23rd.
26,498. "Wireless receiving apparatus." C. H. Woodward. October 24th.
26,503. "Two-coil holder for wireless apparatus." H. L. Wood. October 24th.
26,506. "Crystal detectors." W. C. J. Schlie. October 24th.
26,512. "Commutator for motor-cars." F. Saar. October 24th.
26,513. "Wireless aerials." J. Crossley, J. Crossley & Co., Ltd., and P. M. Thompson. October 24th.
26,518. "Wireless receiving apparatus." Richmond Electric Co., and J. Rogers. October 24th.
26,546. "Electric couplings, terminals, &c." M. Koopman. October 24th.
26,547. "Electric cookers." W. Service. October 24th.
26,552. "Panels and units for wireless installations, &c." C. S. Lambton and F. Nelson. October 24th.
26,553. "Detector for wireless telegraphy, &c." L. S. Rayner and L. J. Shine. October 24th.
26,575. "Wireless receiving apparatus." H. Kirschfeldt. October 24th.
26,586. "Dynamo-electric machines." Tilling-Stevens Motors, Ltd., and H. K. Whitehorn. October 24th.
26,592. "Tungsten arc lamps." General Electric Co., Ltd. October 24th. (Germany, May 5th.)
26,593. "Wireless receiving arrangements." A. E. Chapman. October 24th.
26,605. "Automobile head-lamps, &c." N. C. Hall. October 24th.
26,608. "Variable resistance devices." Burndept, Ltd., and S. F. Woodell. October 24th.
26,614. "Wireless receiving apparatus." Mann, Egerton & Co., Ltd., and H. R. Taunton. October 24th.
26,619. "Thermionic valves." H. Wade (Mills Novelty Co.). October 24th.

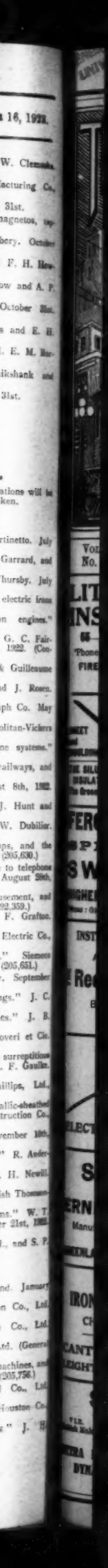
26,625. "Horns for wireless apparatus, gramophones, &c." Sir C. S. Forbes. October 24th.
26,627. "Electric transmission systems." A. M. Taylor. October 25th.
26,651. "Machines for winding electric coils." E. W. Pattison (Dictograph Products Corporation). October 25th.
26,650. "Tuning systems for wireless apparatus." H. W. Forshaw and L. S. Palmer. October 25th.
26,667. "Head-lamps for motor vehicles." W. J. Smith. October 25th.
26,675. "Electric heating elements." Falkirk Iron Co., Ltd., and J. W. Yuille. October 25th.
26,698. "Vacuum discharge devices." H. E. Watson. October 25th.
26,702. "Crystal detectors." P. Morley. October 25th.
26,710. "Thermionic apparatus." F. Holweck. October 25th. (France, October 27th, 1922.)
26,716. "Terminal-connecting means." A. H. Curtis and Igranic Electric Co., Ltd. October 25th.
26,717. "Adjustment of inductance coils." A. H. Curtis, G. Dandridge, and Igranic Electric Co., Ltd. October 25th.
26,721. "Electrical etching of metals." G. J. Sutton. October 25th.
26,733. "Automatic-reclosing circuit-breaker systems." British Thomson-Houston Co., Ltd. (General Electric Co.). October 25th.
26,734. "Electric switches." British Thomson-Houston Co., Ltd., and H. F. Farmer. October 25th.
23,739. "Aerials, &c., for wireless apparatus." C. A. Simpson. October 25th.
26,751. "Electric heating." A. D. Pou. October 25th.
26,754. "Crystal receivers for wireless telephony." R. B. Matthews. October 26th.
26,771. "Wireless receiving sets." H. J. Brookes. October 26th.
26,772. "Tapped coils for wireless, &c., apparatus." F. R. Stocks. October 26th.
26,780. "Electric resistances." H. B. Prentice. October 26th.
26,788. "System of motor control." O. Ellefsen. October 26th.
26,799. "Electric fuses." F. Coates and A. Reyrolle & Co., Ltd. October 26th.
26,800. "Electric synchroscopes, &c." P. F. Harris and A. Reyrolle and Co., Ltd. October 26th.
26,805. "Devices for production and amplification of electric oscillations." A. R. Angus. October 26th.
26,827. "Manufacture of continuously-loaded electric conductors." J. T. Griffin and Western Electric Co., Ltd. October 26th.
26,828. "High-frequency transmission." Western Electric Co., Ltd. (Western Electric Co. Inc.). October 26th.
26,830. "Electric protective arrangements." B. H. Leeson and A. Reyrolle and Co., Ltd. October 26th.
26,837. "Automatic telephone systems." H. E. Humphries and Siemens Bros. & Co., Ltd. October 26th.
26,843. "Engine starters." Metropolitan-Vickers Electrical Co., Ltd. October 26th. (United States, November 23rd, 1922.)
26,849. "Electric condensers." E. H. Trump. October 26th.
26,852. "Automatic telephone systems." T. Lenaghan. October 26th.
26,857. "Manufacture of telephone cables." C. F. Street. October 26th.
26,867. "Sound-producing apparatus for signalling, &c." Chance Bros. and Co., Ltd. October 26th.
26,870. "Electric contact-makers for motor vehicles." J. H. Runbaken and W. Torrance. October 26th.
26,871. "Electric power transmitting set." J. de Jong. October 26th.
26,884. "Contact-breaker bush fitter." F. H. May. October 27th.
26,896. "Electric ignition in internal-combustion engines." C. B. Frost. October 27th.
26,904. "Electric condensers." H. Stevens and A. J. Stevens & Co. (1914), Ltd. October 27th.
26,911. "Cooling enclosed electric machines." P. Ehrmann. October 27th. (France, April 27th.)
26,937. "Rectifiers for wireless telephony." W. J. Bowyer. October 27th.
26,950. "Aerials, &c., for wireless telegraphy, &c." J. W. Fothergill. October 27th.
26,957. "Electric plug connections for wireless receiving sets, &c." H. C. Linzell. October 27th.
26,962. "Crystal detectors." S. J. Abbott. October 27th.
27,015. "Electron disharge devices." Western Electric Co., Ltd. October 29th. (United States, November 27th, 1922.)
27,016. "Tuning devices for wireless telegraphy, &c." Lord Egerton of Tatton. October 29th.
27,019. "Electrically-heated cushions, &c." F. M. Lennard and V. G. Steer. October 29th.
27,029. "Push-button switch for electric starting motors." G. Unterberg. October 29th. (Germany, August 6th.)
27,034. "Heat-accumulating electric ranges." A. D. Widström. October 29th. (Sweden, November 17th, 1922.)
27,044. "Electric controllers." H. V. James. October 29th.
27,045. "Stopping devices for electric motors." H. V. James. October 29th.
27,046. "Means for cooling thermionic valves." B. D. L. Mogridge. October 29th.
27,050. "Electric fuses." C. J. Baker, J. H. Collie, and Kartret Switchgear Co., Ltd. October 29th.
27,053. "Anodes for vacuum discharge apparatus." Akt. Ges. Brown, Boveri et Cie. October 29th. (Germany, November 8th, 1922.)
27,055. "Production of alternating currents." S. A. Kukel. October 29th. (Germany, August 28th.)
27,058. "Magneto-electric machines." British Thomson-Houston Co., Ltd., L. Griffiths, and A. P. Young. October 29th.
27,062. "Miners' &c., electric lamps." G. H. Darby and Oldham & Son, Ltd. October 29th.
27,063. "Loud speakers for wireless telephony." W. H. Johns and Johnson and Phillips, Ltd. October 29th.
27,066. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. October 29th. (United States, December 23rd, 1922.)
27,068. "Wiring systems for electric lighting." Johnson & Phillips, Ltd., and H. J. G. Webb. October 29th.
27,096. "Bayonet joint, &c., connections for electric lamps, &c." G. Barber and T. Hough. October 30th.
27,100. "Electric fuses and switches." W. L. Barber, W. G. H. Cox, and Midland Electric Manufacturing Co., Ltd. October 30th.
27,105. "Anti-dazzle device for head lamps." W. Phillips. October 30th.
27,129. "Vapour lamps." W. Barclay. October 30th.
27,130. "Commutators for ignition apparatus of internal-combustion engines." W. Barclay. October 30th.
27,148. "Multi-pole electric junction boxes." F. Fay. October 30th.
27,151. "Starting systems for internal-combustion engines." Armstrong, Siddeley Motors, Ltd., and F. M. Green. October 30th.
27,168. "Crystal detectors." G. T. Rowell. October 30th.
27,171. "Crystal rectifiers." K. H. Hawkins. October 30th.
27,175. "Wireless telephony." R. Howe-Gould. October 30th. (Union of South Africa, November 3rd, 1922.)
27,176. "Head bands for telephone receivers." T. L. Jones. October 30th.
27,182. "Vacuum electric tube devices." E. Y. Robinson. October 30th.
27,183. "Lead-in device for aerial and earth wires." C. F. Haining. October 30th.
27,217. "Wireless communications." J. M. Blair and W. W. Clemmie. October 30th.
27,236. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. October 30th. (United States, May 17th.)
27,238. "Grids for wireless valves." B. F. Shortt. October 31st.
27,241. "Electric contact make-and-break mechanism for magnetos, tapping keys, &c." J. Baker. October 31st.
27,246. "Crystal holders for wireless reception." C. T. Colbery. October 31st.
27,247. "Condenser for wireless receivers." C. Hewson and F. H. Hewson. October 31st.
27,270. "Carrier for electric lamp shades, &c." A. N. Haddow and A. P. Rutherford. October 31st.
27,319. "Acoustic horns." Western Electric Co., Ltd. October 31st. (United States, March 28th.)
27,320. "Control device for direct-current motors." G. Ness and E. H. Shinn. October 31st.
27,344. "Galvanometer relay, telephone oscillograph, &c." H. E. M. Barlow and L. Barlow. October 31st.
27,349. "Storing and counting electric impulses." W. Cruikshank and F. W. Francis. October 31st.
27,350. "Electric impression switch." F. Scrace. October 31st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

11,184. "Asynchronous induction electric machine." V. Martinetto. July 2nd, 1921. (182,768.)
17,805. "Control of electric motors." A. H. Railing, C. C. Garrard, and W. Wilson. April 13th, 1923. (205,540.)
18,948. "Self-cleaning sparking plug." T. J. Spidy and G. Thursby. July 11th, 1922. (205,542.)
19,478. "Apparatus for taking up the slack flexible cable for electric irons and the like." J. H. Collie. July 15th, 1922. (205,552.)
19,672. "Rotary current distributors for internal-combustion engines." M. M. Ward. July 18th, 1922. (205,562.)
19,708. "Illuminated sign lamp with varying colours." H. G. C. Fairweather (International Radiotelegraf & Telefon Cie.). July 18th, 1922. (Convention date not granted.) (191,361.)
19,739. "Protective covering for submarine cables." Felten & Guilleaume Carlswerk Akt. Ges. July 18th, 1921. (183,464.)
19,850. "Dynamo-electric machines." Sir C. A. Parsons and J. Rosen. July 19th, 1922. (Addition to 203,804.) (205,572.)
19,958. "Telegraph transmitting apparatus." Western Telegraph Co. May 13th, 1922. (197,633.)
20,125. "Electrical resistances." N. E. North and Metropolitan-Vickers Electrical Co., Ltd. July 22nd, 1922. (205,585.)
20,477. "Impulse transmitters for use in automatic telephone systems." A. H. Adams. July 30th, 1921. (183,835.)
21,393. "Switch apparatus for electric and steam tramways, railways, and the like." D. Arcani. August 4th, 1922. (205,609.)
21,495. "Thermionic devices." E. Y. Robinson. August 8th, 1922. (205,613.)
22,835. "Alternating-current dynamo-electric machines." L. J. Hunt and Sandycroft, Ltd. August 22nd, 1922. (205,627.)
22,885. "Connecting device for radio-receiving systems." W. Dubilier. May 23rd, 1922. (198,318.)
23,220. "Brackets and like supports for electric fans, lamps, and the like." M. J. Railing and C. W. Saunders. August 26th, 1922. (205,630.)
23,286. "Mounting of electric terminals, particularly applicable to telephone receivers and like electromagnetic devices." C. Brandes, Inc. August 26th, 1922. (199,343.)
23,772. "Systems for the telephonic distribution of news, amusement, and the like." Western Electric Co., Ltd. January 25th, 1922. (192,359.)
23,832. "Brush holders for dynamo-electric machines." W. F. Grafton. September 2nd, 1922. (205,634.)
24,254. "Electrical fuses." F. Shergold and Edison Swan Electric Co., Ltd. September 7th, 1922. (205,641.)
24,972. "Automatic and semi-automatic telephone systems." Siemens Bros. & Co., Ltd., and D. A. Christian. September 15th, 1922. (205,651.)
25,771. "Submarine cables and telegraph lines." H. Tinsley. September 23rd, 1922 (205,658.)
25,935. "Electric lamp-holders and the like electric couplings." J. C. White. September 26th, 1922. (205,660.)
26,611. "External spark-gaps for internal-combustion engines." J. B. Wright and J. Robinson. October 2nd, 1922. (205,666.)
27,442. "Electric transformer oil-boxes." Akt. Ges. Brown, Boveri et Cie. October 15th, 1921. (187,222.)
28,509. "Device for preventing the theft of motor-cars and the surreptitious use of electrical apparatus in general." H. V. M. Fell and W. F. Gaulke. October 19th, 1922. (205,681.)
28,604. "Manufacture of telephone cables." Johnson & Phillips, Ltd., and C. F. Street. October 20th, 1922. (205,685.)
30,202. "Electrical bonding junction boxes for use with metallic-sheathed wires and the like." S. J. Bryce and Callender's Cable & Construction Co., Ltd. November 6th, 1922. (205,709.)
30,806. "Wireless receiving apparatus." B. G. Calver. November 10th, 1922. (205,717.)
31,013. "Automatic interrupters for electric heating apparatus." R. Anderson. November 28th, 1921. (189,771.)
31,079. "Head-lights of motor vehicles." C. W. Dons and R. H. Krevil. November 14th, 1922. (205,721.)
31,253. "Enclosed electric switchgear." H. Trencham and British Thomson-Houston Co., Ltd. November 15th, 1922. (205,732.)
34,836. "Junction boxes for use in electrical distribution systems." W. T. Henley's Telegraph Works Co., Ltd., and E. E. Judge. December 21st, 1922. (205,742.)
35,490. "Wireless masts or like structures." C. P. Elwell, Ltd., and S. P. Wing. December 30th, 1922. (205,744.)

1923.

80. "Shield for radiography and radioscopy." A. O. Akerlund. January 2nd, 1922. (191,082.)
455. "Electric incandescent lamps." British Thomson-Houston Co., Ltd. (General Electric Co.). January 5th, 1923. (205,747.)
1,768. "Circuit-breaker systems." British Thomson-Houston Co., Ltd. (General Electric Co.). January 19th, 1923. (205,753.)
1,940. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). January 22nd, 1923. (205,754.)
2,175. "Suspenders for use in electric permanent hair-waving machines, and for other electrical purposes." I. Calvete. January 24th, 1923. (205,756.)
3,314. "Electrical insulators." Metropolitan-Vickers Electrical Co., Ltd. April 1st, 1922. (195,593.)
5,712. "Electric selective control systems." British Thomson-Houston Co., Ltd. March 25th, 1922. (195,363.)
6,663. "Starting mechanism of internal-combustion engines." J. H. Witham. March 8th, 1923. (205,763.)